3177

LIBRARY
FISH & WILDLIFE SERVICE
PACIFIC OCEANIC FISHERY
INVESTIGATIONS

PARASITIC COPEPODS IN THE UNITED STATES NATIONAL MUSEUM

BY

CHARLES BRANCH WILSON

No. 3177.—From the Proceedings of the United States National Museum
Vol. 94, pp. 529–582, pls. 20–34

SMITHSONIAN INSTITUTION
UNITED STATES NATIONAL MUSEUM
WASHINGTON, D. C.
1944

PROCEEDINGS OF THE UNITED STATES NATIONAL MUSEUM

issued *by the*

SMITHSONIAN INSTITUTION
U. S. NATIONAL MUSEUM

Vol. 94 Washington : 1944 No. 3177

PARASITIC COPEPODS IN THE UNITED STATES NATIONAL MUSEUM

By Charles Branch Wilson [1]

This report completes the identification and description of all the parasitic copepods in the United States National Museum collection. During the progress of identification 14 species and 1 variety were found to be new to science, and 6 of these required the establishment of new genera for their reception. This material also contained the missing sex of 6 other species of which one sex had already been described and figured. In addition one new name has been bestowed. These 22 additions to the parasitic copepods previously known are described and discussed in systematic order as follows:

CALIGOIDA

Dysgamus atlanticus Steenstrup and Lütken ..... New female ... p. 531
Lepeophtheirus christianensis, new species ..... Both sexes .... p. 533
Lepeophtheirus eminens, new species ..... Both sexes .... p. 535
Lepeophtheirus marcepes, new species ..... Female only .. p. 536
Achtheinus dentatus Wilson ..... New male .... p. 537

HARPACTICOIDA

Unicalteutha ovalis, new genus and species ..... Both sexes .... p. 541

CYCLOPOIDA

Ostrincola gracilis, new genus and species ..... Both sexes .... p. 543
Parmulodes verrucosa, new genus and species ..... Female only .. p. 545
Pestifer agilis, new genus and species ..... Female only .. p. 546

[1] Dr. Wilson died on August 18, 1941, a few weeks after the manuscript of this paper was submitted.—Editor.

558871—44

LERNAEOPODOIDA

Brachiella squali, new species ..... Female only .. p. 547
Lernaeosolea lycodis, new genus, new species ..... Female only .. p. 548
Krøyerina elongata Wilson ..... New male .... p. 549
Paeonodes exiguus, new genus, new species ..... Both sexes .... p. 550

ARGULOIDA

Argulus indicus Weber ..... New male .... p. 552
Argulus intectus, new species ..... Both sexes .... p. 553
Argulus longicaudatus, new species ..... Both sexes .... p. 555
Argulus lunatus, new species ..... Both sexes .... p. 557
Argulus latus Smith ..... New male .... p. 560
Argulus megalops spinosus, new variety ..... Both sexes .... p. 563
Argulus rotundus, new species ..... Female only .. p. 564
Argulus trilineatus Wilson ..... New male .... p. 566
Argulus diversus, new name ..... Both sexes .... p. 572

Fourteen other species are dealt with in this paper:

CALIGOIDA

Dysgamus rhinodontis (Wright) ..... p. 533
Achtheinus dentatus Wilson ..... p. 537
Teredicola typica Wilson ..... p. 539

CYCLOPOIDA

Asterocheres lilljeborgii Boeck ..... p. 547

ARGULOIDA

Argulus japonicus Thiele ..... p. 558
Argulus melanostictus Wilson ..... p. 565
Argulus biramosus Bere ..... p. 568
Argulus canadensis Wilson ..... p. 568
Argulus niger Wilson ..... p. 569
Argulus varians Bere ..... p. 570
Argulus maculosus Wilson ..... p. 570
Argulus paulensis Wilson ..... p. 572
Argulus nattereri Heller ..... p. 573
Argulus salminei Krøyer ..... p. 574

Order COPEPODA

Suborder CALIGOIDA

Family CALIGIDAE

Genus DYSGAMUS Steenstrup and Lütken, 1861

DYSGAMUS ATLANTICUS Steenstrup and Lütken

PLATE 29, FIGURES 139–148

Dysgamus atlanticus STEENSTRUP and LÜTKEN, 1861, p. 368, pl. 4, fig. 8.—SCOTT, 1912, p. 579, figs. 1–4, pl. 13, fig. 13.

Steenstrup and Lütken established a new genus and species of parasitic copepods upon 10 male specimens captured swimming freely in the plankton of the north Atlantic. Scott's specimens were also all males obtained in the plankton of the Atlantic both north and south of the Equator. A second species, *Nogagus murrayi*, was described and figured by Brady (1883, p. 136), who failed to recognize it as belonging to the genus *Dysgamus*, a fact discovered by Leigh-Sharpe (1934, p. 28). The latter considered a third species, *D. ariommus* (Wilson, 1907a, p. 713), to be synonymous with Brady's species, admitting differences that the present author believes may distinguish the two. The fourth known representative of this genus is *D. longifurcatus* (Wilson, 1923, p. 11).

In every instance the specimens upon which the species were established were males captured in the surface plankton. In the copepods the characteristics of the female form the basis for generic and specific distinctions and the characteristics of the male are regarded as secondary. As a result the validity of the genus and its four species has remained more or less tentative during the 80 years since the first was established. Now, however, examination of a dozen females taken by Dr. L. Howell Rivero from the skin of a whale shark (*Rhineodon typus*) off Habana, Cuba, substantiates the validity of the genus and its type species, *D. atlanticus*. This discovery also increased the possibility of making valid the other three species by suggesting that further search may reveal the females of some or even all of them. The female allotype and paratypes of this species have been deposited in the Museum of Comparative Zoology at Harvard University.

Female.—Carapace almost circular, slightly wider than long, with a short and narrow lobe at each posterior corner tipped with a small spine. The frontal plates are long and wide with convex anterior and posterior margins; the lateral lobes are widened posteriorly and partially divided at the center. The median posterior lobe is a little less than half the width of the carapace and reaches slightly beyond the tips of the lateral lobes. The fourth segment is free and one-fourth as wide as the carapace, with convex lateral margins. The median

posterior lobe of the carapace and the free fourth segment each carry a pair of dorsolateral plates. Those on the posterior lobe are subcircular in outline, inclined ventrally and have a smooth margin. Those on the fourth segment are oblong with a smooth anterior margin and a toothed posterior margin, which is covered by the anterior shoulders of the genital segment. In the dorsal view (fig. 139) the lateral projections between these two pairs of plates are the basipods of the third legs, the rami being turned inward and invisible. The genital segment is half as long and two-thirds as wide as the carapace, with a short and broad lobe at each posterior corner bearing on its ventral surface a fifth leg tipped with five setae and extending beyond the posterior margin of the lobe. The abdomen is relatively small, one-sixth as wide and long as the genital segment and made up of a single segment. It has a posterior median sinus, which reaches beyond the center, and a lobe on each side of the sinus that reaches the center of the caudal ramus. The caudal rami are rodlike, four times as long as wide and inclined inward, each tipped with four setae.

The first antennae are 2-segmented, the basal segment stout and covered with short spines, the end segment cylindrical, shorter than the basal segment and tipped with four hairlike setae. The second antenna is made up of two segments and a terminal claw. The basal segment is stout and curved strongly backward with a rodlike seta in the hollow of the curve and the second segment is very short and unarmed. The terminal claw is curved forward giving the whole appendage a pronounced S-curve and carries an accessory spine on its outer margin near the base. The second maxilla is 3-segmented, the basal segment unarmed, the second segment with spines and a knob at its distal end, the terminal segment flattened with a corrugated margin, a curved spine at the tip and a row of acicular spines along the central surface. The maxilliped has a stout basal segment and a strong curved claw with a small spine on its inner margin near the base. The four pairs of legs are all biramose and the rami are 2-segmented, with the spines and setae arranged as follows: First endopod 0–0:1–3, exopod 1–0:4–3; second endopod 1–1:1–8, exopod 1–1:4–6; third endopod 1–1:0–6; exopod 1–1:3–6; fourth endopod 1–0:5–0; exopod 6–0:9–0. In the first and fourth legs the endopods are two-thirds as long as the exopods; in the other two pairs of legs the rami are equal. Total length, 6 mm. Carapace, 3.7 mm. long.

Remarks.—The discovery of a female confirms the validity of the genus and since the original generic diagnosis was based upon males only we may add the following from these females: Carapace and free segment like those of the male but with a pair of small dorsal plates on the third and fourth segments. Genital segment large, more than half the size of the carapace; abdomen 1-segmented, at-

tached to the ventral surface of the genital segment and more or less covered by the latter. The males have always been found swimming freely in the plankton, as active as any of the pelagic forms, but the females, like those of all the other Caligidae, are fixed to their host and are never taken in the tow. The size and scarcity of their hosts help to explain why no females have hitherto been secured.

It is worthy of repetition here that Bassett-Smith (1899, p. 460) declared he had personally examined many specimens of both sexes of *Dysgamus* in the British Museum.

DYSGAMUS RHINODONTIS (Wright)

Stasiotes rhinodontis WRIGHT, 1876, p. 583, pl. 35, figs. 1–14.

Wright established a new genus and species of copepods upon female specimens taken from the gills of a "shark (*Rhinodon typicus*)," collected in the Seychelles northeast of Madagascar. The name *Stasiotes* was used 12 years previously by Jan for a snake genus, and a new name was suggested by the present author (1907c, p. 439). Comparison of Wright's original description and figures with those given above for *Dysgamus atlanticus* proves that the two species are congeneric. The two species cannot be regarded as synonymous, however, as there are many differences in the proportions and markings of the body regions and in the details of the appendages, especially the second antennae, the maxillipeds, and the fourth legs. Accordingly Wright's specimens retain the original specific name and will be known as *Dysgamus rhinodontis* (Wright).

Genus LEPEOPHTHEIRUS Norman, 1832

LEPEOPHTHEIRUS CHRISTIANENSIS, new species

PLATE 28, FIGURES 124–131

Thirty specimens, including both sexes, were obtained from a sea catfish (*Galeichthys* sp.) at Pass Christian, Miss. The female holotype and male allotype are U.S.N.M. No. 60548.

Female.—Carapace circular in outline, as wide as long and highly vaulted dorsally; median posterior lobe more than half the carapace width and scarcely projecting behind the lateral lobes. The latter are very short, curved inward, and bluntly rounded at their tips. The central longitudinal ribs are widely separated and diverge anteriorly. The free segment is reduced to a fourth of the width of the carapace and is contracted to a short neck anteriorly. The genital segment is acorn-shaped, three-fourths as long and five-eighths as wide as the carapace, narrowed into a short neck anteriorly and almost squarely truncated posteriorly. Abdomen 1-segmented, one-fourth as long

and wide as the genital segment; caudal rami very short, each tipped with three setae. The abdomen is on a level with the dorsal surface of the genital segment and is much thinner than the latter.

First antennae long and slender, the end segment tipped with three setae of equal length. Second antenna 3-segmented and tipped with a long claw, bent at right angles near its tip, which is very acuminate. First maxilla in the form of a simple, straight, and slender spine with an acuminate, not a bipartite, tip. Maxilliped with a long and slender basal segment, which is twice the length of the terminal claw. The latter is rather weak but well curved with an accessory spine on the concave margin near its center. The basipod of the first leg carries the rudiment of an endopod at the distal posterior corner, which is club-shaped and covered with short hairs. The fourth leg is 4-segmented, the basal segment swollen but little, the three terminal segments combined about as long as the basal segment, each with a long slender spine at its outer distal corner and the end segment with two other longer terminal spines and a very short one at the inner corner. There are rudimentary fifth legs on the ventral surface of the genital segment in front of the bases of the egg strings. Each consists of a small semicircular knob tipped with 3 setae and a short distance outside the knob on the ventral surface of the genital segment is another single seta. Total length, 3.50 mm. Carapace, 1.60 mm. long and wide. Egg strings, 1.80 mm.

Male.—Carapace a little more than half the entire length, which is much less than in the female and as long as wide. The lobes and dorsal markings are like those of the female except that the lateral lobes are relatively wider. The free segment is a fifth as long and wide as the carapace and the genital segment is barrel-shaped, nearly half as long as the carapace, the anterior end narrowed more than the posterior, the sides strongly convex. There are two pairs of leg rudiments, one just behind the center of the segment and the other at the posterior corners. The abdomen is 1-segmented, two-fifths as long, half as wide, and fully as thick as the genital segment. The caudal rami are small, well separated and divergent, each with three setae.

The antennae, mouth parts, and swimming legs are like those of the female except that the claw on the second antenna is very much stouter with a strongly swollen base and three blunt coarse spines on the concave margin. The first three pairs of legs are like those of the female, but the fourth pair are relatively longer and nearly reach the posterior margin of the genital segment. Total length, 2.50 mm. Carapace, 1.30 mm. long and wide.

Remarks.—This new species can be readily distinguished by the general proportion of the body regions, the peculiar grooving of the dorsal surface of the carapace, and the conspicuous testes in the male.

LEPEOPHTHEIRUS EMINENS,[2] new species

PLATE 28, FIGURES 132–138; PLATE 29, FIGURE 149

Seven females and 14 males were taken from the outside surface of a black marlin (*Makaira ampla marlina*) captured at Ventura Bay on the coast of Baja California. The female holotype and male allotype are U.S.N.M. No. 79636.

Female.—Carapace elliptical, narrowed a little anteriorly and widened posteriorly, the anterior margin evenly rounded, with a well-defined sinus at the center. Median posterior lobe half the width of the carapace and extending slightly back of the lateral lobes, the latter broad and evenly rounded. Free segment less than a third as wide as the carapace with strongly convex lateral margins. Urosome a little more than half as long as the metasome; genital segment wider than long and half as wide as the carapace, with parallel sides and rounded lobes at its posterior corners. Abdomen longer than the genital segment and two-fifths as wide, made up of two segments, which are more or less fused with each other and with the caudal rami. The latter are nearly as wide as long and each is armed with five setae, the middle one the longest.

Antennae and mouth parts of the usual type for the genus; the second maxillae have a long terminal segment swollen at its center and armed there with a small spine on the inner margin. The terminal portion beyond the swelling is divided longitudinally and the slender halves are curved and bluntly rounded at their tips. The terminal claw of the maxillipeds is stout, strongly curved, and acuminate. The furca is shaped like the letter H, the sides straight and parallel, the distal portion longer than the proximal. The basipod of the first legs has a 2-segmented rudimentary endopod attached to its posterior distal corner. The end segment of the exopod is tipped with four curved claws of about the same size. The fourth leg is stout and 4-segmented, the basal segment longer than the three terminal segments combined, the latter about equal in length, each tipped with a claw. Total length, 6 mm. Carapace, 3.95 mm. long, 3 mm. wide.

Male.—Carapace elliptical, one-sixth longer than wide, the anterior margin rather flat with a central sinus larger than in the female. The median lobe is narrower and extends farther behind the lateral lobes. The free segment is little more than a fourth the width of the carapace, its lateral margins protruding strongly. The genital segment is elliptical, a little longer than wide, without posterior lobes or even corners. The abdomen is nearly as long as the genital segment and half as wide and is made up of two segments. As in

[2] *Eminens*, protruding, with reference to the corners of the genital segments.

the female, the two abdominal segments and the caudal rami are more or less completely fused.

The antennae, mouth parts, and swimming legs are like those of the female except for the fourth legs. These are stout and the three terminal segments combined are longer than the basal segment. The spine at the distal corner of the second segment is short and strongly curved and the three terminal spines are very unequal in length. Total length, 6 mm. Carapace, 3.66 mm. long, 3.15 mm. wide.

Remarks.—The presence of lobes at the posterior corners of the genital segment in the female and the more or less complete fusion of the two abdominal segments with each other and with the caudal rami in both sexes are the best characters for identification.

LEPEOPHTHEIRUS MARCEPES,[3] new species

PLATE 33, FIGURES 192–195

Forty specimens, all females, were taken by Dr. Waldo L. Schmitt from the gills and under surface of a lemon sole (*Pleuronectes quadrituberculatus*) caught in Alitak Bay, Kodiak Island, Alaska. One, U.S.N.M. No. 79687, has been selected to serve as the type of this new species.

Female.—Carapace elliptical, 10 percent longer than wide, the lateral lobes narrowly rounded and not reaching the posterior margin of the median lobe. Front of the carapace broad and flattened, with a median incision. Fourth segment one-third as wide as the carapace, its sides strongly convex. Genital segment longer and wider than the carapace, narrowed anteriorly to the width of the fourth segment, the posterior corners broadly rounded and the posterior margin concave. Abdomen longer than the genital segment but only a fourth as wide and 2-segmented, the proximal segment 12 times as long as the anal with parallel sides.

The antennae and mouth parts are of the usual type for this genus, without specific characters. The first legs are short and rather stout, the end segment with three terminal claws diminishing in size backward and three large plumose setae on the posterior margin. The second and third legs are of the typical biramose form, but the fourth legs are very exceptional for this genus. Although the adult female averages 6 mm. in length these fourth legs are only 0.16 mm. long and easily escape any but the most careful examination. When sufficiently magnified, however, they are revealed as 3-segmented, the basal segment with a seta at the anterior distal corner, the second segment diagonal with a stout spine at its outer corner, and the third segment with two very unequal terminal spines. The egg strings are

[3] From *marceo*, to shrink or shrivel.

narrower than the abdomen and vary in length from 1.75 mm. to 5 mm.

The two segments of the abdomen are more or less fused but the joint is plainly indicated by lateral invaginations. The anal segment has a shallow invagination at the center of the posterior margin, the corners on either side protruding in a rounded process. The caudal rami are about as wide as long, are inclined toward each other and rounded at their tips, each with four unequal setae on the tip and outer margin. Type, 6.50 mm. long. Carapace, 1.50 mm. long, 1.35 mm. wide. Genital segment, 2 mm. long, 2.50 mm. wide. Abdomen, 2.20 mm. long, 0.52 mm. wide. Egg strings, about 2.50 mm. long, eggs rather thick.

Remarks.—The greatly shriveled fourth legs are such an exceptional character that every one of the specimens was examined to make sure they were all alike. None were found with larger legs but two or three had smaller ones and these legs thus furnish the most convenient means of identifying the species. The shriveling is all the more noticeable in contrast with the size of the adult and has suggested the specific name. Other specific characters are the unusual proportions of the body regions and the great dissimilarity in the size of the abdominal segments.

Family PANDARIDAE

Genus ACHTHEINUS Wilson, 1908

ACHTHEINUS DENTATUS Wilson

PLATE 33, FIGURES 196–208

Achtheinus dentatus WILSON, 1911, p. 630, pl. 67, figs. 22–31; 1921, p. 6 (except male described on p. 8), pl. 3, figs. 20–27.

Thirty females were taken from the outside surface of a hammerhead shark (*Sphyrna zygaena*) caught at Estero de la Luna in the Gulf of California. Of these females, 18 carried a male attached in sexual union and one female had two attached males. The ventral surfaces of the two sexes were together and the anterior margin of the male carapace was pushed as far forward as possible under the fourth legs of the female. A male, U.S.N.M. No. 79701, attached to a female, has been selected as the allotype.

Male.—Carapace subovate, considerably narrowed anteriorly and reentrant on the frontal margin, as wide as long, the posterior lobes reaching the fourth segment. Two pairs of dorsal plates on the thorax behind the carapace, much smaller than in the female and confined to the lateral margins of the segments. Genital segment quadrangular, without a dorsal plate but with a rudimentary fifth

leg at each posterior corner. Between this leg and the side of the abdomen a flat rounded lamina is attached on each side to the posterior margin of the genital segment on a level with its dorsal surface. The abdomen is triangular, 1-segmented, with the apex posterior; the caudal rami are curved, widely separated and nearly as long as the abdomen, each armed with four setae of about the same size.

The first antennae are 2-segmented and elongate, the segments of equal length and armed with stout spines. The second antennae are smaller than those of the female, the terminal claw strongly curved and transversely wrinkled at its base but without any trace of teeth. The mouth tube is short and pointed; the inside mandibles are slender and flattened, with a row of 10 or 12 curved teeth along the inner margin at the tip. The outside first maxillae are conical, each tipped with a stout spine and having 2 small slender spines on the anterior margin. The second maxilla has a slender and curved terminal segment one and a half times as long as the stout basal segment and bipartite at its tip. The maxilliped has a swollen basal segment and a stout and slightly curved terminal claw.

The first four pairs of legs are biramose, the rami of the first three pairs 2-segmented, of the fourth pair 1-segmented, the setae distributed as in figures 205 to 208. In the first and fourth pairs the exopod is considerably longer than the endopod, in the second and third pairs the rami are about equal. Total length, 3 mm. Carapace, 2 mm. long, 1.86 mm. wide.

Remarks.—Inasmuch as every one of the present males was attached to a female in sexual union, it is absolutely certain that they are the true males of the species and as such are the first to be described for the genus. In two other instances, however, other males have unfortunately been ascribed by the present author to species of this genus. The opportunity is taken here to make the necessary corrections:

1. Wilson (1912, p. 235): Two males of a lot of two males and three females that were obtained from the pectoral fin of a sawfish off the Cape of Good Hope. Since these five specimens were associated upon the same host with no other parasitic copepods present, the author assumed that they were the two sexes of the same species and so described them under the name *Achtheinus pinguis*. The three females were correctly diagnosed and they still remain the types of the species *pinguis*, but a comparison of the males with those here described discloses the fact that they do not belong to the genus *Achtheinus* but that they must be referred to the genus *Nesippus*.

2. Wilson (1921, p. 6): Two males of a lot of six females and three males that were taken from the outside skin of *Mustelus lunulatus* off southern California. These were referred to the present

species, *Achtheinus dentatus*, and were so described and figured. The two males of this original lot were mistakenly considered immature females and the supposedly unique male described as the male type of *A. dentatus*. However, if the description and figures of those so-called immature females be compared with the figures of the females here described it is at once apparent that they are not females but the true males of the species *A. dentatus*. The single male first described as the type male of this species differs radically from the males that correctly represent this species.

The males here described having now been established as true males, it becomes necessary to replace the male generic diagnosis of the genus *Achtheinus* previously given:

Male diagnosis: Carapace elliptical, without conspicilla; posterior lobes conical, without accessory lobes. Free thorax comparatively wide, its two pairs of dorsal plates confined to the lateral margins; genital segment without a dorsal plate, but with fifth leg rudiments. Abdomen triangular, wholly visible dorsally. Second antennae stout, blunt, and without teeth. Maxillae conical, maxilliped with a strong terminal claw. Four pairs of biramose swimming legs, rami of first three pairs 2-segmented, of the fourth pair 1-segmented.

Genus TEREDICOLA Wilson, 1942

TEREDICOLA TYPICA Wilson

PLATE 31, FIGURES 172–179

Teredicola typica WILSON, 1942, p. 60, fig. 1.

This species was described from a dozen specimens including both sexes taken from the body cavities of Teredos in Honolulu Harbor, Oahu, Hawaii, by Dr. C. H. Edmondson. A single male and a female were selected to serve as types of the genus and species, U.S.N.M. No. 79639. The original diagnosis was as follows:

Female: First three thoracic segments more or less fused with the head and with one another to form a cylindrical body a little more than twice as long as wide. Fourth and fifth segments reduced to a third of the width of the first and second segments, the fifth segment twice as long as the fourth. Genital segment about the same size as the fifth segment and subspherical in form. Abdomen 3-segmented, the first and third segments about the same width and length, the second segment shorter and a trifle narrower. Caudal rami narrow cylindrical, as long as the anal segment and widely divergent, each with two terminal setae as long as the ramus itself.

First antennae 6-segmented, the two basal segments considerably widened, the third segment the longest and the fifth segment the shortest, all except the basal segment bearing setae. The second maxilla and maxilliped are each made up of a single stout segment tipped with a strong claw, the one on the maxilla acute and curved into a semicircle, the one on the maxilliped blunt and nearly straight. Two pairs of biramose swimming legs, the rami 2-segmented and of approximately the same length. Each end segment is armed with many setae

of different lengths; each basal exopod segment has two small setae at its outer distal corner, while the basal endopod segments are unarmed.

Total length 4.43 mm. Enlarged cylindrical body 3.20 mm long, 1.50 mm wide.

Male: Much smaller than the female, the body made up of ten segments, the first three considerably widened, the remaining seven regularly tapering a little backward. The head is fused with the first thoracic segment, which carries a lateral plate or lamella on each side. The next three segments also carry lateral plates diminishing in size to become mere knobs on the fourth segment. The fifth segment, genital segment, and the four abdominal segments have convex lateral margins and differ but little in length. The caudal rami are like those of the female except that each has four terminal setae, the two outer ones very short, the middle ones as long as the ramus.

The first antennae arise from the dorsal surface of the head close to the anterior margin and are strongly curved backward. The mouth parts and swimming legs are like those of the female.

Total length 2.35 mm. Width of first segment, including wings, 1 mm.

Remarks.—So far as known, this represents the first occurrence of internal copepod parasites reported from the shipworm, *Teredo*. In view of the large number of Teredos that have been handled in the course of many studies of these destructive mollusks, the copepod parasite here described cannot be very common or it would have been found before. Concerning its occurrence, Dr. Edmondson has written me as follows:

"The copepod was first observed during the fall of 1939, when fully 75 percent of the specimens of *Teredo milleri* Dall, Bartsch, and Rehder (1938) over 30 mm in length recovered from Honolulu Harbor were found to be parasitized. The parasite has appeared in shipworms at three additional localities about Oahu, and also in Hilo Harbor, Hawaii, and at Kahului, Maui.

"Six shipworms, five species of *Teredo* and one of *Bankia*, in Hawaiian waters are known to serve as hosts of the parasite.

"The female clings tightly to the lining of the infrabranchial cavity of the host by means of stout, sharp mouthparts, while the male is likely to be unattached in the cavity and when released from the host is capable of swimming quite freely. Because of the greatly inflated body the female is capable of but slight movement when detached from the shipworm."

Suborder HARPACTICOIDA

Family PELTIDIIDAE

UNICALTEUTHA,[4] new genus

Body broadly oval and considerably flattened, the carapace followed by three dorsal epimeral plates turned ventrally on their

[4] From *unicus*, singular, especially in its habitat, + *Alteutha*.

lateral margins. The fifth segment with a small dorsal plate not wide enough to reach the lateral margins and concealed in dorsal view beneath the epimeral plate of the fourth segment. Genital segment more or less divided transversely, the halves with a conical process at each posterior corner. Caudal rami wider than long, the second inner seta greatly elongated.

First antennae 9-segmented in the female, 6-segmented in the male and geniculate, the terminal part made up of two segments. Mandibular palp biramose; maxilliped chelate. First four pairs of legs biramose, the rami 3-segmented, fifth legs uniramose, 2-segmented.

Remarks.—This genus is closely related to *Alteutha* but differs enough from it in the body proportions, the dorsal epimeral plates, the first and fifth legs, and the male antennae to be established as a separate genus.

Genotype.—*Unicalteutha ovalis*, new species.

UNICALTEUTHA OVALIS, new species

PLATE 34, FIGURES 209–218

Eighteen females and 4 males were obtained by Prof. W. Templeman from the outside surface of lobsters in Placentia Bay, Newfoundland, late in June 1939, while he was carrying on investigations for the Fisheries Research Institute at St. John's. A female and a male have been selected as holotype and allotype, respectively, of the new species, U.S.N.M. No. 79695.

Female.—Body elliptical and strongly depressed and expanded laterally as in *Alteutha*. Head fused with the first segment and covered with a carapace one-fourth wider than the length on the midline, its lateral margins turned down with acute posterior corners. The first three segments behind the carapace are covered with short dorsal epimeral plates, the first one as wide as the carapace, the other two successively narrower. All three of these plates are turned down at their lateral margins and acutely produced at their posterior corners. The third of these plates is longer than either of the others and extends backward to cover and conceal the fifth segment in dorsal view. The fifth segment is only two-fifths as wide as the fourth and has a dorsal plate which is transversely elliptical and does not reach the lateral margins of the segment, but it does project backward a little over the genital segment.

The urosome is only a fifth as long as the metasome and is strongly flattened. The genital segment is as wide as the fifth segment and is partially divided by lateral invaginations. The posterior corners of each half are produced conically backward and are armed with short setae. The abdomen is 2-segmented, both segments with conical

projections at their posterior corners. The caudal rami are wider than long with a finger projection at each distal corner and three setae diminishing in length outward, the inner one being nearly twice the length of the urosome. The eggs are carried in a single ovisac, which is considerably larger than the entire urosome.

The first antennae are 9-segmented, the second segment much longer than any of the others, all the segments well armed with setae. The second antennae are 3-segmented, the terminal segment longer than either of the others, the exopod very small and indistinctly segmented. The mandibular palp is biramose, the rami of about equal length and heavily armed with setae. The maxilliped is tipped with a strong chela. The first four pairs of legs are biramose, the rami 3-segmented. In the first legs the endopod is considerably longer than the exopod and the basal segment much longer than the two distal segments combined. The second segment has a stout curved spine on its inner margin and the end segment has two stout claws turned outward. The basal segment of the exopod has a large outer seta, the second segment has a seta at each distal corner, the outer one enlarged at its base. The end segment has three outer, two terminal, and one inner seta, the outer ones with enlarged bases. In the second, third, and fourth legs the arrangement of the setae is shown in figures 215–217. The exopods of the fourth legs reach beyond the tips of the caudal rami and the last two segments are visible in dorsal view behind the dorsal epimeral plates and outside the genital segment. The fifth legs are uniramose and 2-segmented, the segments of equal length and setose, the terminal one fringed with hairs on its outer margin. Total length, 1.35 mm. Width of carapace, 0.825 mm.

Male.—Body relatively wider and shorter than in the female; carapace three-tenths wider than long. The dorsal epimeral plates diminishing in width more rapidly backward but increasing in length so that the posterior margin of the third plate reaches behind the center of the genital segment. The posterior corners of the carapace and the epimeral plates are longer and more acute than in the female. The urosome is relatively shorter and wider, the caudal rami are considerably wider than long, with the inner terminal seta more than twice as long as the urosome.

The first antennae are 6-segmented and geniculate, the end section made up of two segments, the basal of four segments, of which the second is the shortest and the third the longest. In the end section the terminal segment is three times as long as the penultimate segment. The second antennae, mouth parts, and first four pairs of legs are like those of the female. The fifth legs are 2-segmented but the basal segment is one-half longer than the distal segment and is armed with a long and stout spine at its distal inner corner. Total length, 1.20 mm. Width of carapace, 0.85 mm.

Remarks.—A commensal harpactid has been taken from the branchial chamber of a land crab in Jamaica and the curious form *Balaenophilus* has been found upon the baleen plates inside the mouth of the great blue whale. This is the first harpactid to be obtained from the outside surface of any host. The hard chitin shell of the lobster, however, offers a serious obstacle to true parasitism. Like *Balaenophilus* it is probably to be regarded as a commensal profiting by the well-known scavenger habits of its host.

Suborder CYLCOPOIDA

Family ERGASILIDAE

OSTRINCOLA, new genus

Head fused with the first segment; segments 2 to 5 of varying lengths but diminishing regularly in width. Genital segment longer than wide with convex lateral margins in the female and parallel margins in the male. Abdomen 3-segmented in the female, 2-segmented in the male; caudal rami much elongated and cylindrical.

First antennae 8-segmented in the female, the six distal segments much shorter than the two basal, 8-segmented also in the male but the segments more nearly equal. Second antennae uniramose and 4-segmented, the end segment a curved claw. First four pairs of legs biramose, rami 3-segmented, fifth pair uniramose, 3-segmented, the end segment enlarged into a circular disk in the female.

Genotype.—*Ostrincola gracilis*, new species.

OSTRINCOLA GRACILIS, new species

PLATE 34, FIGURES 219–227

Four females and three males were taken from the mantle cavity of the common oyster (*Ostrea virginica*) at Beaufort, N. C., by H. J. MacDonald in August 1929. One female and one male are designated as holotype and allotype, respectively, of the new species, U.S.N.M. No. 79697.

Female.—Head fused with the first segment into an acorn-shaped cephalothorax as wide as long. Second segment as wide as the cephalothorax, the following segments diminishing regularly in width, the fourth segment with slightly projecting posterior corners, the third and fifth segments longer than the second and fourth. Genital segment subcordate, a little longer than wide, and narrowed posteriorly. Abdomen 3-segmented, the segments diminishing in length and width posteriorly, the anal segment a third as long as the basal and half as wide. Caudal rami cylindrical, very narrow, and four times as long as the anal segment, each tipped with three minute setae.

First antennae 8-segmented, the two basal segments long and cylindrical, the six distal segments much shorter and about as wide as long. Second antennae 4-segmented, the first and third segments each four times as long as the second, the end segment a stout curved claw. First four pairs of legs biramose, rami 3-segmented and about equal in length with the spines arranged as in figures 223–225. Fifth legs uniramose and 3-segmented, the two basal segments short and cylindrical, the end segment enlarged into a vertical circular disk curved like a reflector with the concave side toward the genital segment and fitting over the convex surface of the latter. Eggs carried in two ovisacs, each cylindrical and containing three or four eggs. Total length, 1.10 mm. Width of cephalothorax, 0.25 mm.

Male.—Body similar to that of the female but a little smaller. Head separated from the first segment, the two combined relatively longer; second, third, fourth, and fifth segments about the same length but diminishing in width like those of the female, the fifth segment about half as wide as the second. Genital segment rectangular, a little longer than wide with nearly straight sides. Abdomen 2-segmented, the anal segment longer than the basal with a posterior median incision that reaches beyond the center of the segment. Caudal rami cylindrical but only one-half longer than the anal segment, each with three terminal setae and two or three on the outer margin.

First antennae 8-segmented as in the female, but here the two basal segments are scarcely any longer than the others. Second antennae, mouth parts, and first four pairs of legs like those of the female. Fifth legs 3-segmented and uniramose but the end segment is not enlarged as in the female. Total length, 0.80 mm. Width of head, 0.20mm.

Remarks.—This genus is closely related to Ramsay Wright's genus *Myicola* (1885, p. 120) from the common clam. It differs, however, in the actual and relative size of the two sexes, the details of the body regions, the two pairs of antennae, and the first and fifth legs. There is as much difference between these parasites of the clam and the oyster as there is between the hosts on which they live.

Family CLAUSIDIIDAE

PARMULODES,[5] new genus

Body suborbicular and strongly flattened; head fused with the first segment and covered with a semicircular carapace, second segment free; segments 3 to 5 fused and covered with another carapace smaller than the first and extending back over the genital segment and abdomen, the latter 2-segmented. First antennae 18-segmented, with many setae; second antennae uniramose and uncinate. Mouth a long and narrow sucking tube; first maxillae linear and tripartite at the

[5] From *parmula*, a little round shield.

tip; second maxillae and maxillipeds uncinate. First four pairs of legs biramose, rami 3-segmented, fifth pair uniramose and 1-segmented.

Genotype.—Parmulodes verrucosa, new species.

PARMULODES VERRUCOSA, new species

PLATE 30, FIGURES 150–160

A single female, the type of the genus and species, U.S.N.M. No. 79000, was obtained from a coral tidal flat at Matecumbe, Fla., in July 1925.

Female.—The anterior carapace and the posterior dorsal plate are evenly rounded, with uniform elliptical outline, broken only by the interval of the second segment. The outer rim is slightly thickened and punctured with a row of skin glands extending around the entire margin and similar to those in the larvae of the genus *Argulus*. They are farther apart and slightly smaller in the posterior plate than in the carapace. When enlarged they exhibit definite structure as seen in figure 151 but their function is very problematical. The second segment is covered with a narrow ribbonlike plate whose ends are turned down ventrally and when lifted up to a level with the carapace do not quite reach the margin of the latter. The posterior corners of the carapace are prolonged slightly backward, the anterior corners of the plate slightly forward, and they almost meet in the center of the space between the two. The fifth segment is widened a little at its posterior margin through the bases of the fifth legs, and the genital segment is widened across its anterior margin through the openings of the oviducts. The abdomen is made up of two short segments of about the same length, each wider than long. The caudal rami are about the same width and length, inclined a little outward, each tipped with three setae.

The first antennae are attached some distance behind the anterior margin. Each is made up of 18 segments, the basal segment very long and stout, the remaining segments short, of varying lengths, and diminishing gradually in width distally. The terminal segment just reaches the margin of the carapace, and every segment carries one or more setae, the proximal ones much longer than the distal. The basal segment of the second antenna is stout and longer than the other two segments combined, with a short spine at its inner distal corner. The second segment is uniform in width and unarmed, the third segment is one-fourth as long as the second, with a tiny spine on its outer margin. The terminal claw is twice as long as the third segment, nearly straight and abruptly narrowed at its tip.

The mouth tube is strongly swollen at its base, then narrowed into a long slender tube extending backward between the bases of the legs.

The first maxilla is a long slender rod divided into three very slender prongs at its tip. The second maxilla has a stout basal segment and a long, stout, somewhat twisted claw. The basal segment of the maxilliped is rather slender and the terminal claw is nearly straight. The first four pairs of legs are biramose and the rami are 3-segmented; the arrangement of the spines and setae on the first and third legs is shown in figures 159 and 160. The fifth legs are uniramose and 1-segmented with two terminal setae and one on the outer margin near the tip, and a fringe of short hairs proximal to this outer seta. Total length, 1.15 mm. Greatest width, 0.65 mm.

Remarks.—This genus resembles *Clausidium* in its general make-up and undoubtedly belongs to the same family, but it differs in so many particulars from the other members of the family that it must be placed in a genus by itself.

PESTIFER,[6] new genus

Head and first four thoracic segments more or less fused to form a cylindrical body; fifth segment free, much narrower than the fourth segment but wider than long. Genital segment subspherical, wider than long; abdomen small, 1-segmented; caudal rami jointed.

First antennae slender, 7-segmented, segments very unequal in length; second antennae and maxilliped prehensile. Four pairs of biramose legs, rami 2-segmented, the endopods much shorter than the exopods. Egg strings cylindrical, eggs minute and very numerous.

Genotype.—*Pestifer agilis*, new species.

PESTIFER AGILIS, new species

PLATE 31, FIGURES 165–171

Two females with ovisacs were obtained from the skin of an annelid dredged from a depth of 380 fathoms, July 18, 1932, near the Tortugas Islands in the Gulf of Mexico. One has been selected as the holotype, U.S.N.M. No. 79641.

Female.—Description the same as for the genus. Cylindrical body three times as long as wide, narrowed anteriorly, broadly rounded posteriorly. Fifth segment four times as wide as long and about the same width as the genital segment, which is one-third wider than long. The abdomen is minute and is made up of a single segment twice as wide as long with a deep posterior sinus. Caudal rami cylindrical and longer than the abdomen, each tipped with a single-jointed seta. The egg strings are cylindrical and two-thirds as long as the entire body; the eggs are minute and very numerous, 2,500 to 3,000 in each ovisac. The first antennae are slender and 7-segmented,

[6] *Pestifer*, bringing vexation.

the third segment longer than the 3 following segments combined, the only setae terminal on the end segment. The maxilliped is 4-segmented, the end segment transformed into a stout claw sharply bent at the center. The four pairs of legs are biramose, the rami 2-segmented, the exopods longer than the endopods, the basipod segments completely fused.

Remarks.—This is another new genus infesting annelids at considerable depths and it evidently belongs to the family Clausidiidae. Its most striking characteristics are the very large maxillipeds, the rami of the swimming legs, and the jointed caudal rami. Total length, 6.24 mm. Ovisacs, 4.16 mm.

Family ASTEROCHERIDAE

Genus ASTEROCHERES Boeck, 1859

ASTEROCHERES LILLJEBORGII Boeck

PLATE 30, FIGURES 161, 162

Asterocheres lilljeborgii BOECK, 1859, p. 176 [6].

This species has been noted by many European authors but this is the first record from American coasts. A single female, U.S.N.M. No. 78909, was obtained from the outside surface of a north Pacific starfish (*Henricia leviuscula*) on the coast of Amlia, one of the Aleutian Islands.

Suborder LERNAEOPODOIDA

Family LERNAEOPODIDAE

Genus BRACHIELLA Cuvier, 1830

BRACHIELLA SQUALI, new species

PLATE 31, FIGURES 163, 164

One of the two females taken from the spiracles of a shark (*Squalus mitsukurii*) by A. Jacot at Tsinan, China, has been selected as the holotype, U.S.N.M. No. 60565.

Female.—Cephalothorax nearly as large as the body and turned backward in line with the second maxillae, the two forming an angle of about 60° with the body axis. Body pear-shaped, narrowed anteriorly where it joins the cephalothorax, broadly rounded and somewhat depressed posteriorly. On a level with the dorsal surface at the posterior end of the body is a flattened slightly bipartite genital process. On each side of this process there issues from the dorsal surface of the body somewhat in front of the posterior margin a short conical process, largest at the base and tapering almost to a point

distally. Each of these processes is about one-third the length and one-fifth the width of the body.

The first antennae are 3-segmented, the basal segment but little swollen; the second pair are biramose, the exopod 2-segmented. The second maxillae are separate to their very tips, which are slightly enlarged and fused; bulla broken off. The maxillipeds are large and much swollen at their base, with a short, stout, and strongly curved claw, which does not reach the level of the mouth tube. Egg strings one-third the diameter of the body and not quite equaling its length; eggs rather large and not very numerous. Total length of body, 4 mm. Greatest diameter, 2 mm. Combined length of cephalothorax and second maxillae, 6 mm. Length of ovisacs, 3.75 mm.

Remarks.—This species can be recognized by the absence of ventral processes and the presence of short dorsal processes above the egg strings. The only other species with dorsal processes alone is *Brachiella lophii* Milne Edwards (1840, p. 514. pl. 41, fig. 4), in which they are pear-shaped instead of conical in form.

LERNAEOSOLEA,[7] new genus

Body cylindrical, bent into the shape of a horseshoe, the "heels" smoothly rounded, the "toe" passing into a narrow neck curved upward and backward and ending in the head. Ovisacs emerging from the sinus behind the base of the neck and extending backward parallel with the sides of the horseshoe. No caudal rami. Two pairs of antennae but no trace of mouth parts or swimming legs.

Genotype.—*Lernaeosolea lycodis*, new species.

LERNAEOSOLEA LYCODIS, new species

PLATE 32, Figures 190, 191

A single female, the holotype, U.S.N.M. No. 60501, was obtained from the flesh of a short brown wolf-fish (*Anarhichas lupus*) at *Albatross* Station 2208 off the coast of New Jersey.

Female.—Description the same as that of the genus. The head is enlarged a little at the top and produced into a median dorsal and two lateral horns on either side. The dorsal horn and the lateral horn nearest on either side are globular knobs; the other two horns are somewhat elongated but end in round knobs and all the horns lie in the same plane at right angles to the axis of the head. The neck is twisted to the right through an angle of 60°, so that its dorsal and ventral surfaces are turned laterally. The ovisacs are narrowly cylindrical, parallel with the sides of the body horseshoe, and reaching a little beyond the tips of the latter.

---

[7] Dr. Wilson did not specify the family for this genus and it is placed here tentatively.—EDITOR.

On the front of the head can be seen a pair of rudimentary first antennae apparently 1-segmented and a pair of second antennae in the form of stout claws evidently used as accessory attachment organs, but there are no traces of mouth parts or swimming legs. Total length from toe to heel of the body horseshoe, 13 mm. Diameter of the sides of the horseshoe, 4 mm. Length of ovisacs, 8.4 mm. Distance of lateral horns from tip to tip, 6.5 mm.

Remarks.—The form and body proportions as given above are sufficient to distinguish this unique copepod from all others.

Family EUDACTYLINIDAE

Genus KRØYERINA Wilson, 1932

KRØYERINA ELONGATA Wilson

PLATE 32, FIGURES 180–185

Krøyerina elongata Wilson, 1932, p. 459, pl. 31, figs. 1-p.

This species was established upon female specimens only from the gills of great blue sharks ("*Galeus glaucus*") at Marthas Vineyard, Mass. The present material consists of 50-odd specimens of both sexes, taken from the gills of a tiger shark (*Galeocerdo tigrinus*), caught at Woods Hole. These are the first males obtained. One has been designated the allotype, U.S.N.M. No. 79613.

Male.—Body elongate and narrow, head fused with the first segment and covered with a triangular carapace one-fifth wider than long. Segments 2 to 4 the same length but diminishing in width; the fused fifth and genital segments one-third longer than the three preceding segments combined and the same width as the fourth segment. Abdomen 3-segmented, the segments diminishing in length and width distally, but the anal segment is still three-fifths as long as the basal segment. The latter has an enlarged ring or collar around its proximal end which looks like an extra segment, but it is not separated. Caudal rami narrow and rodlike, as long as the anal segment, parallel with each other, each tipped with three setae.

First antennae 7-segmented, every segment bearing setae; the second antennae stout and chelate. Second maxillae shorter and stouter than in the female; maxillipeds with a curved terminal claw. The four pairs of swimming legs are biramose, the rami 3-segmented as in the female. Total length, 5–6 mm. Fifth and genital segments, 1.30 mm. long.

Remarks.—This male closely resembles that of *K. nasuta* (Wilson, 1932, p. 457), with these differences: It is more than twice as large, the fused fifth and genital segment is relatively longer, the first abdominal

segment has an enlarged base, and the caudal rami are longer and parallel instead of divergent.

Family SPHYRIIDAE

PAEONODES, new genus

Body separable into cephalothorax, neck, trunk, genital segment, and abdomen. Cephalothorax enlarged into a transverse ellipsoid as in *Paeon;* neck made up of the second thoracic segment and nearly straight; trunk cylindrical and made up of the third and fourth thoracic segments; genital segment distinctly separated and without posterior processes; abdomen also distinct and as long as the genital segment, with well-defined caudal rami.

Two pairs of segmented antennae, the usual mouth parts, and four pairs of biramose swimming legs, the rami 1-segmented.

Remarks.—When first viewed this genus seems to resemble *Paeon* closely but even a cursory examination reveals that the two genera are widely separated. The presence in *Paeonodes* of normal antennae, mouth parts, and swimming legs instead of nondescript processes, the distinct separation of genital segment and abdomen, and the absence of posterior processes all combine to furnish a decisive separation of the genera.

Genotype.—*Paeonodes exiguus*, new species.

PAEONODES EXIGUUS, new species

PLATE 32, FIGURES 187–189

A single female with ovisacs and an attached male was taken from near the eye of an unidentified fish in May 1911, locality not given. These two specimens, U.S.N.M. No. 79642, are holotype female and allotype male of the new species, respectively.

Female.—Head fused with the first thoracic segment and enlarged into a transverse ellipsoid twice as wide as long. The second segment constitutes a neck as long as the third and fourth segments combined and about the same diameter throughout. The body is made up of the fused third and fourth segments, the former three times as long as the latter, judged by the position of the swimming legs. The diameter increases backward until it becomes twice as wide at the posterior end. The genital segment is spherical and half as wide as the posterior end of the body, with the ovisacs attached to the center on either side. The abdomen is only half as wide as the genital segment, but it is nearly as long and 1-segmented. The caudal rami are about as wide as long and each is tipped with a single seta. The ovisacs are cylindrical, half as long and a third as wide as the body, and the eggs are minute and numerous.

The first antennae are small and 3-segmented, each segment armed with tiny setae; the second antennae are prehensile and disproportionally large, each tipped with a strong curved claw having an accessory spine on its inner margin near the base. Mouth parts small but of normal shape and not at all like the nondescript processes in *Paeon*. There are four pairs of biramose legs spaced as in figure 187, the first pair just behind the head and the last pair just in front of the posterior end of the body, the spaces between pairs in the proportions 5: 4: 1.50. The rami are 1-segmented, and the exopods and endopods are about the same length. Total length, 3.15 mm. Width of head, 1 mm.

Male.—A pygmy male was fastened so securely to the ventral surface of the third thoracic segment of the female that the two could not be separated without very serious mutilation. Consequently it was deemed wise to leave them intact and to be satisfied for the present with the knowledge that the male is a pygmy attached to the female, as in other genera of the Sphyriidae.

Suborder ARGULOIDA

Family ARGULIDAE

Genus ARGULUS Müller, 1875

During the preparation of this paper an article on the genus *Argulus* by O. Lloyd Meehean (1940) was published. This article added many valuable data to our knowledge of the Argulidae, especially with reference to the respiratory areas and the supporting rods of the sucking cups. Upon these two features, combined with the accessory sex characters of the legs of the male, Meehean established a key to the species of the genus. Such a key has been greatly needed for a long time, and if this one be supplemented with the structural characters of the various appendages its usefulness will be increased. I have therefore incorporated these characters in Meehean's key, which I have added as a supplement to this paper (p. 576). As it stands in Meehean's paper, however, too much specific value has been placed upon the areas and rods and not enough upon other structural characters, with the result that formerly accepted species of *Argulus* have been reduced to synonyms. A discussion of the validity of these species makes up the remainder of the present paper. Such a discussion is quite appropriate, since this paper is so largely concerned with species belonging to the genus *Argulus*.

The removal by synonymy of as large a number of species of *Argulus* as advocated by Meehean constitutes a serious encroachment upon the genus. Consequently the mere statement that one species is the synonym of another is not sufficient. Actual proof must be

offered by a careful comparison of the structural details of the two species. Such proof is here offered in the comparison of species claimed as synonyms by Meehean, but it results in proving their validity rather than their synonymy.

In all Meehean keyed out 26 species. Of these one needed a new name, *A. diversus* being given to Meehean's *A. maculosus;* other material was wrongly identified as *A. salminei* Krøyer, which consisted in part of *A. natterreri* and *A. paulensis* both of Wilson. Including the latter, the present author reestablishes the validity of eight species that Meehean put into synonymy. This gives us 37[8] species of *Argulus* for which a diagnostic key is given on p. 576.

ARGULUS INDICUS Weber

PLATE 22, FIGURES 34–39, 48

Argulus indicus WEBER, 1892, p. 544, fig. 1.—KAMPEN, 1909, p. 447, figs. 5, 6.

This species was first established upon female specimens from the coast of Java by Max Weber and afterward by P. N. Kampen. Both descriptions were very meager, with one figure by Weber and two by Kampen. A single female was obtained by Dr. H. M. Smith from the skin of a fighting fish (*Betta*) at Bangkok, Thailand, and sent to the present author, by whom it was more fully described (Wilson, 1927). Dr. Smith later obtained 10 females and 11 males from the skin and fins of *Trichopodus pectoralis* at Bangkok. As these are the first males to be collected they are fully described and figured and a single specimen of each sex is U.S.N.M. No. 78896, the male being the allotype.

Male.—Carapace ovate, considerably narrowed anteriorly, with broad lateral lobes, which fall slightly short of the abdomen, just reaching it or slightly overlapping it, no two specimens agreeing exactly in relative length. Cephalic area broadly triangular, distinctly separated from the rest of the carapace and projecting a little anteriorly. The two median ribs are curved and bifurcate at their anterior ends like those of the female, and the ribs in the lateral lobes also are arranged similarly. The respiratory areas are divided into a very large posterior portion and a comparatively minute anterior portion. Again this is like the arrangement in the female except that here in the male the large posterior portion is considerably curved inward and its anterior end is more or less truncated instead of evenly rounded. The compound eyes are relatively larger than those of the

[8] Two species overlooked by Meehean, and not included in Wilson's key, are *A. cubensis* Wilson and *A. rhamdiae* Wilson. *A. cubensis* was taken by Dr. L. Howell Rivero from the gills of a fresh-water cichlid in Cuba (Wilson, 1936a). *A. rhamdiae* was taken by Dr. A. S. Pearse (Wilson, 1936b) from the skin of a species of *Rhamdia* caught in one of the cenotes of Yucatán.—EDITOR.

female and are similarly removed some distance from the anterior margin and are widely separated. The abdomen is acorn-shaped, contracted into a short neck where it joins the thorax and then abruptly widens until the width equals the length. The posterior sinus is one-fourth of the length and the caudal rami are subterminal. The paired testes are elongate-elliptical and do not quite reach the base of the posterior sinus. Their anterior ends are tapered into the ducts leading to the vesicle and the posterior ends are bluntly rounded.

The first and second antennae are almost exactly like those of the female; the claw on the second segment of the first antenna is near the posterior margin. On the ventral surface of the proximal segment of the second antenna close to its base are two unequal spines. The supporting ribs in the margin of the sucking disks are shown in figure 36; they are well separated and each is made up of three rather indistinct segments, the terminal one enlarged at its proximal end. The teeth of the marginal fringe are much wider at the base than in the female. The maxilliped (fig. 48) is considerably stouter than that of the female, especially in the three terminal segments, but the terminal claw is no larger. The first two pairs of legs have flagella, the third leg is shown in figure 38; the proximal basipod segment has a short and acute spine at its posterior distal corner and the distal basipod segment has a large sac opening on its posterior margin. The rim of the opening is thickened and produced into two finger processes on the ventral side near the basipod. In the fourth leg (fig. 39) the lobe on the basal segment is larger than the entire basipod and in dorsal view projects beyond the lateral margin of the abdomen and is densely fringed with hairs. The second segment has a pointed process at its anterior distal corner, which curves forward and outward and has an acuminate tip. Total length, 7.50 mm.

Remarks.—The exceptionally large posterior lobe on the proximal segment of the fourth basipod is the most prominent characteristic of this male. Coupled with the brown spots distributed over the entire dorsal surface of the body it will furnish a ready means of identification. The large number of specimens obtained from *Trichopodus pectoralis* suggests that it is the real host of this copepod.

ARGULUS INTECTUS, new species

PLATE 22, FIGURES 40–47

One female and one of the three males of this new species, obtained from the outside surface of a scup (*Stenotomus chrysops*) at Woods Hole, Mass., are the holotype and allotype of the new species, U.S.N.M. No. 78891.

Female.—Carapace elliptical, one-tenth longer than wide and broadly rounded both anteriorly and posteriorly. Posterior lobes

reaching only the middle of the second thoracic segment, leaving all the rest of the thorax uncovered, whence the specific name. The cephalic area is ovate and 70 percent of the carapace length; the compound eyes are proportionally large, well separated and removed from the anterior margin. The respiratory areas are peculiar; the smaller one is circular in outline and lies inside the larger one near the anterior end of the latter. This anterior end is narrowed outside the smaller area and abruptly widened behind it and curved backward and inward, the posterior end enlarged somewhat. The second and third thoracic segments are the same width but the third is slightly the longer. The fourth segment is both shorter and narrower and its lateral margins are strongly convex. The abdomen is elliptical, one-half longer than wide and about one-fifth the total length. The posterior sinus is a third of the abdomen length and the caudal rami are lateral, each upon a shoulder of the lateral margin of the sinus at its center. The seminal receptacles are circular, close together and close to the anterior margin of the abdomen. They are partially obscured in dorsal view but are plainly visible on the ventral surface.

In the first antennae the spine on the anterior margin is stout and curved inward while the lateral spine is long and slender and bent into a half circle. The curve of this spine extends considerably beyond the tip of the flagellum, which is 2-segmented and tipped with three small setae. The second antennae are 4-segmented, the posterior spine on the basal segment slender and acuminate. The supporting rods in the margin of the sucking disks are close together and 6-segmented. The basal segment is cylindrical and as long as the other five combined, which are beadlike, tapered distally, and tipped with a tiny spine. The pad on the basal segment of the maxilliped carries three slender acuminate spines and the end segment is armed with three small claws. The swimming legs reach beyond the lateral margins of the carapace, the first two pairs bearing flagella. The proximal segment of the fourth basipod has a posterior process without a heel, but with an acuminate toe which projects well beyond the lateral margin of the abdomen. Total length, 2.30 to 2.55 mm. Carapace, 1.70 mm. long, 1.50 mm. wide.

Male.—Similar to the female but a little larger, the carapace elliptical and broadly rounded both anteriorly and posteriorly, one-fourth longer than wide, and reaching the posterior margin of the second segment. The cephalic area is as long as in the female, the posterior sinus equally broad and shallow. The second and third thoracic segments are about the same length with nearly straight sides, the fourth segment is narrower and shorter with convex sides. The abdomen is one-half longer than wide, its lateral margins more convex than in the female. The testes are elongate-elliptical and reach nearly to the base of the posterior sinus, which is one-fourth the

abdomen length. The caudal rami are lateral upon shoulders of the sides of the sinus as in the female. Here that portion of the sinus anterior to the caudal rami is closed so that the rami appear to be basal, but even the pressure of a cover glass is sufficient to open the sinus and show that the rami are really lateral.

The antennae and maxillipeds are like those of the female except that the spines on the basal plate of the latter are short and stout and not very pointed. The swimming legs are simple and without accessory sex characters; the boot on the fourth basipod has no heel but the toe is longer and more pointed than in the female and nearly the whole boot is visible in dorsal view. Total length, 2.6 to 2.8 mm.

Remarks.—This is the next to smallest species thus far described and its diminutive size, together with the relative shortness of the carapace, the shoulders on the sides of the posterior sinus of the abdomen, and the peculiar shape of the respiratory areas are its distinguishing characters.

ARGULUS LONGICAUDATUS, new species

PLATE 23, FIGURES 49–56

One female and one of two males taken from the outside surface of a crappie (*Pomoxis annularis*) caught in Lake Dallas, Tex., have been designated holotype and allotype of the new species, U.S.N.M. No. 78892.

Female.—Carapace elliptical, one-fourth longer than wide, narrowed a little anteriorly but still broadly and evenly rounded, with the posterior lobes just reaching the anterior third of the third thoracic segment. The compound eyes are small, far forward, and well separated; the cephalic area is a little more than half the carapace length. The respiratory areas are very indistinct; they consist of a large posterior curved area and a minute, circular anterior area, the two areas well separated. The second, third, and fourth thoracic segments diminish in width and length backward. The abdomen is obovate, nearly as long as the four thoracic segments combined and a little less than twice as long as wide. The posterior sinus is three-quarters of the entire length and the lobes taper rapidly distally and end in sharp tips. The seminal receptacles are small, circular, and close to the anterior margin; the caudal rami are basal. Through its basal portion in front of the posterior sinus the abdomen is one-third wider than the thorax and its anterior corners are broadly rounded.

The first and second antennae are slender and of about equal length; in the first pair the basal segment has a blunt spine at its inner corner, the second segment has a small straight spine on its anterior margin, and the curve of the lateral claw reaches the center of the

last segment of the flagellum. There is also a large spine on the posterior margin of this second segment and the flagellum is 3-segmented. The second antenna is 4-segmented, with a stout spine on the basal segment and two slender spines at the tip of the third segment. The sucking disks are of medium size and far forward; the supporting rods in their margins are 7- or 8-segmented (fig. 51). The basal segment is narrower and longer than any of the others, which gradually diminish in length and width distally, the terminal ones being flattened disks. The maxilliped is slender and its basal plate is armed with three slender, curved spines. The first three pairs of legs are of the usual pattern and there are no flagella on any of them. On the fourth legs instead of the usual boot-shaped appendage a flattened lamina extends backward from the basal segment. Its posterior margin is divided by a shallow sinus into two rounded lobes covered with stiff hairs. The second basipod segment has a row of four slender acuminate spines on its ventral surface along the posterior margin. Total length, 7 mm. Carapace, 4 mm. long, 3.25 mm. wide. Abdomen, 2.25 mm. long.

Male.—Carapace elliptical, one-third longer than wide, the posterior lobes not reaching the center of the second thoracic segment. Cephalic area 65 percent of the carapace length, the compound eyes larger and not so far forward as those of the female. The respiratory areas are like those described for the female and are a little more distinctly visible. The four thoracic segments are about the same length and width but the fourth segment is narrowed posteriorly to join the abdomen. The latter is longer than the four thoracic segments combined and one-half wider. The posterior sinus does not quite reach the center and is broadly triangular; the caudal rami are basal and only just visible dorsally. The testes are exceptionally large and fill nearly the entire space in the abdomen. Each is elongate-ovate, considerably narrowed posteriorly, and extends back into the posterior lobe to the center of the sinus.

The antennae and maxillipeds are like those of the female except that the latter are stouter and the ventral surface of the last three segments is covered with short spines. The swimming legs are long and slender and none of them exhibit any accessory sex details except the fourth pair (fig. 56). Here the second basipod segment is abruptly reduced in diameter on its anterior margin near the center of the segment. Attached to the reduced portion close to the notch is a spherical knob, which stands out prominently and serves as an excellent character for identification of the species. Total length, 3.96 mm. Carapace, 1.98 mm. long, 1.50 mm. wide.

Remarks.—This species is readily recognizable by the shape and length of the abdomen in both sexes and by the knob on the anterior

margin of the fourth basipod in the male. When this copepod is alive it must be highly colored, as even in the preservative the thorax retains a deep orange hue and the carapace and abdomen have a bluish tinge, probably a bright blue in the living copepod.

ARGULUS LUNATUS, new species

PLATE 23, FIGURES 57–63; PLATE 24, FIGURES 64–66

Eight females and four males were obtained from the outside surface of goldfish (*Carassius auratus*) at Norfolk, Va. One female and a male have been designated the holotype and allotype, U.S.N.M. No. 78893.

Female.—Carapace broadly elliptical, somewhat narrowed anteriorly, with wide posterior lobes that reach the anterior margin of the abdomen. Posterior sinus broad and flaring, one-third the carapace length and squarely truncated at its base. Cephalic area 58 percent of the carapace length; eyes large and far forward but well separated. Respiratory areas elongate-elliptical, the anterior one much smaller than the posterior and the two in contact along a transverse line. The four thoracic segments are all the same width and the first three are the same length, while the fourth is shorter but is not narrowed posteriorly. The abdomen is obovate, longer than wide with broadly rounded anterior corners and narrow posterior lobes bluntly rounded at their tips. The sinus does not reach the center of the abdomen, and the caudal rami are lateral, each mounted on a shoulder near the base of the sinus. The seminal receptacles are circular, of medium size, and widely separated close to the anterior corners.

The first antennae are narrow and elongate, the two proximal segments fused, with no spine at their base or on the posterior margin, but with a short and stout spine on the anterior margin. The lateral claw is curved into a half circle and reaches the tip of the flagellum. The second antennae are 5-segmented, the two basal segments enlarged, the end segment lanceolate. The supporting rods of the sucking disks are made up of seven or eight elliptical segments gradually diminishing in size distally and tipped with a twisted rod. The basal segment of the maxilliped is stout and longer than the three distal segments combined, the basal plate is wide and the three spines are short, stout, and blunt. The raised area is covered with coarse spines and smaller spines are scattered over the entire ventral surface of the appendage. The first two pairs of legs have flagella and the two basipod segments of all four pairs are more or less completely fused. In the fourth legs the part corresponding to the proximal basipod segment is prolonged backward into a flap, which is broadly rounded at its tip and fringed with hairs but bears no resemblance to a boot,

having neither heel nor toe. Total length, 5 mm. Carapace, 3 mm. long, 2.95 mm. wide.

Male.—Carapace orbicular, not narrowed anteriorly, a little wider than long and reaching only the fourth segment. Cephalic area 58 percent of the carapace length, the eyes larger than in the female and farther forward. The respiratory areas are similar but the dividing space between them is diagonal rather than horizontal. The four thoracic segments are the same width and the first three are the same length, but the fourth is only half as long as the others and its posterior margin is a half circle. The abdomen is elliptical, one fifth longer than wide, with no anterior corners. The testes are 80 percent of the abdomen's length and distinctly lunate, whence the specific name. The posterior sinus is one-third of the length of the abdomen, the tips of the posterior lobes rounded. The caudal rami are lateral, attached to shoulders on the sides of the sinus near its base.

The antennae are similar to those of the female while the spines on the basal plate of the maxilliped are longer, curved and acuminate (fig. 65). The proximal segment of the basipod of the second leg has two long finger processes on its posterior margin (fig. 63). The same segment in the third leg is swollen posteriorly but otherwise unmodified. In the fourth leg the proximal basipod segment has a posterior lamina very much shorter than in the female, and the distal segment has an acute process at its anterior outer corner. Total length, 4 mm. Carapace, 3 mm. long, 3.02 mm. wide.

Remarks.—After this species had been described and the figures drawn the specimens suffered a severe drying, but the specific characters still remain visible. From *A. japonicus*, which it most resembles, this species may be distinguished in the female by the shape of the fourth segment and the abdomen and by the structural details of the antennae, the maxillipeds, the respiratory areas, and the ribs of the sucking disks. In the male the most striking difference is to be found in the distinctly lunate form of the testes, curved toward each other with acute ends.

ARGULUS JAPONICUS Thiele

PLATE 24, FIGURES 67–73

Argulus japonicus THIELE, 1900, p. 48; 1904, p. 39, pl. 8, figs. 94–98.

This is properly an Asiatic species that has been imported into the United States along with the influx of goldfish, which have risen rapidly to popularity in recent years. As goldfish have been distributed to aquaria and artificial ponds these parasites have spread with them and have become very common.

Thiele (1900) founded his new species upon female specimens taken from goldfish at Tokyo, Japan. Later (1904) he obtained supple-

mentary specimens, including both sexes, from goldfish at Yokohama and gave a more detailed description. More recently specimens, also including both sexes, were taken from goldfish at Tokyo and sent to the National Museum. They differ from Thiele's in a few details. For this reason, and more especially to afford a ready means of comparison between this species and *A. lunatus*, the Tokyo specimens are here described and figured.

Female.—Carapace circular, as wide as long and reaching just beyond the anterior margin of the fourth thoracic segment, the rami of the first three pairs of legs and nearly all of the fourth pair being visible dorsally. Compound eyes of medium size, far forward and well separated; median eye farther back and very small. Anterior ends of the median ribs distinctly forked, the cephalic area much longer than wide. Second and third thoracic segments much wider than long, fourth segment narrower, with a constriction at the center of each lateral margin. Abdomen elliptical, one-half longer than wide and contracted into a short neck where it joins the thorax. Posterior sinus narrow and V-shaped, less than a quarter of the abdomen length, the caudal rami basal, the posterior lobes short and broadly rounded.

Basal portion of the first antenna short with a curved and bluntly rounded spine on its inner margin. Second segment with a stout, acute spine on the anterior margin, a curved acute spine on the ventral surface near the posterior margin and a slender lateral claw curved into a half circle. Second antenna 6-jointed, the basal joint enlarged and armed with a long blunt spine at its inner end. The five terminal segments are each about the same length and extend well beyond the tip of the first antennae. The maxilliped is fairly stout, its basal plate with a raised knob covered with spines on its ventral surface and three long acuminate posterior spines. There are no flagella on the swimming legs and the basal segment of the fourth leg has a small semicircular flap on its posterior margin. Each supporting rib in the margins of the sucking disks is made up of nine small segments like a row of beads, all about the same size, and the fringe on the margin is a row of flattened spatulate laminae with bluntly rounded tips. Total length, 6 mm. Carapace, 4 mm. long.

Male.—Considerably smaller than the female, the carapace just reaching the abdomen and leaving less of the legs visible in dorsal view. Abdomen more regularly elliptical in outline and the posterior sinus a little deeper. The testes are elongate-ovate and tapered backward and extend into the posterior lobes.

The antennae and mouth parts are similar to those of the female; in the second legs the proximal segment has two large knobs covered with small spines projecting from the posterior margin. In the third

legs the second segment has a large seminal receptacle on the dorsal surface. Both segments of the basipod of the fourth legs have curved projections on the posterior margin and in addition there is an acute peg at the distal anterior corner of the second segment. As here presented (fig. 73) it reaches considerably beyond the distal end of the segment but can evidently be drawn back by muscles connected with it into the position represented in Thiele's figure (1904, pl. 8, fig. 97). Total length, 3.5 mm.

Remarks.—A careful comparison of the details in the figures of *A. japonicus* and of *A. lunatus* will give evidence that they belong to separate species. There is considerable superficial resemblance but not a single characteristic can be found showing exact correspondence.

ARGULUS LATUS S. I. Smith

PLATE 27, FIGURES 108–115

Argulus latus S. I. SMITH, *in* Verrill and Smith, 1873, p. 574.
Argulus funduli MEEHEAN, 1940, p. 498 (part).

Smith's type specimens were all females and that is the only sex thus far described. Two males, accompanied by two females, caught swimming freely in the plankton of one of the brackish-water ponds on Chappaquiddick Island off the northern end of Marthas Vineyard, are the first to be discovered and since the previous descriptions of the female have been rather limited a full description of both sexes is here presented. They are U.S.N.M. No. 60452.

Female.—Carapace orbicular, 14 percent wider than long, the anterolateral sinus very shallow, the posterior sinus fully as wide as deep, the posterior lobes broadly rounded and not reaching the center of the third thoracic segment. Fourth segment only two-thirds as wide as the third segment and reduced another third where it joins the abdomen. The latter is obcordate, one-half longer than wide and considerably narrowed posteriorly. The posterior sinus is a little more than one-third the entire length with nearly parallel sides. The caudal rami are subbasal, close to the bottom of the sinus and usually appearing basal owing to the closure of the sinus behind them. The seminal receptacles are proportionally large and elliptical.

The first antennae have neither a claw nor a knob on the anterior margin of the second segment. The lateral claw is small and weak and its curve reaches only the center of the basal segment of the flagellum. The latter is stout, 3-segmented and the terminal segment is not forked. The second antennae are 4-segmented, the first segment longer than the second and third combined, with a blunt spine on the posterior margin at the base. The compound eyes are far forward and just behind the second antennae; they are of medium

size and well separated. The sucking disks are very large for so small a copepod, between a third and a fourth of the carapace width and so widely separated that their outer edges often appear outside the edge of the carapace. The supporting rods in the margins of the disks are made up of 18 segments regularly imbricated and slightly tapered distally. The maxillipeds are slender, the end segment tipped with a finger process and a straight spine. The basal plate is small and its posterior border is slightly bilobed, but without teeth or any sort of projection. The first two pairs of legs have no flagella and the basipod of the fourth leg has only a semicircular lamella with no indications of a heel. In spite of the width of the carapace all the legs project well beyond its lateral margins. Total length, 2.3 to 3 mm. Carapace, 2 mm. long, 2.25 mm. wide.

Male.—Carapace ovate, slightly wider than long and considerably narrowed anteriorly, the cephalic area about as wide as long, the compound eyes fully as far forward as in the female, the median eye quite close behind them and fairly visible. The posterior lobes are very broadly rounded and reach beyond the anterior margin of the fourth segment and the posterior sinus is narrower than in the female, only half as wide as deep. The fourth thoracic segment is half as long and two-thirds as wide as the third segment with convex sides. The abdomen is elliptical, one-third longer than wide and more than half as long as the carapace. The posterior sinus is about a fourth of the entire length and the caudal rami are subbasal on lateral shoulders near the base of the sinus. The testes are elongate elliptical, narrowed posteriorly, and just reaching the base of the sinus.

The first and second antennae are like those of the female, the lateral claw on the second segment of the first antenna even weaker than in the female. The supporting rods of the sucking disks have one or two fewer segments and are just as fully imbricated, and the disks themselves are fully as large. The maxillipeds are much stouter and the segments are shorter, the end segment armed with three curved claws and a lamella, which in turn is tipped with a small curved claw. The basal plate has a smooth posterior margin without spines or processes and without a boss on its ventral surface. The only accessory sexual characters on the second, third, and fourth legs are a swelling on the posterior margin of the third basipod and a minute triangular process on the posterior margin of the fourth basipod. Total length, 2.25 mm. Carapace, 1.43 mm. long, 1.50 mm. wide.

Remarks.—Meehean (1940, p. 468) said of this species: "The male of *A. latus* Smith * * * has never been reported because it is indentical with *funduli* Krøyer * * * so far as the available

specimens are concerned." The two males here described furnish a manifest contradiction to this statement. They were properly labeled and available in the collection of the National Museum. Meehean (1940, p. 499) examined and rejected them because "the males were immature so that the accessory copulatory apparatus was not developed far enough to tell whether there were any specific differences." Specific differences are not confined to the accessory copulatory apparatus. The very use of the word accessory refutes such an idea and we turn to a consideration of the other characteristics to which these are accessory.

These two males were found in company with two females that were certainly *A. latus*, and the natural assumption would be that the four were the two sexes of the same species. The males are just the right size for adult males of the species *latus;* the respiratory areas, the supporting rods of the sucking disks, and the first and second antennae are like those of the female *latus*. The maxillipeds are prehensile as would be expected in males, but the basal plate has neither spines on its posterior margin nor a boss on its ventral surface and so far corresponds to those of the female. Finally, the abdomen shown in figure 109 is as different from the abdomen of the *funduli* male, shown in figure 123, in size, shape, posterior sinus, and the position of the caudal rami, and in the shape and size of the testes as is necessary for specific differentiation. With an abdomen of the relative size here shown and a pair of enlarged testes crammed with sperm it would seem as if these males might be considered sufficiently developed to be assigned to the species *latus*. The abdomen alone shows that they cannot now be placed in the species *funduli* and it is doubtful if sufficient changes will ever occur in further development to allow them to be placed there.

In spite of such manifest specific differences these specimens identified as and labeled *A. latus* by the present author were recorded by Meehean as synonyms of *A. funduli*. He remarked (1940, p. 499) that "Smith's description of *A. latus* is not full enough to enable one to determine whether he has established a true species." Meagerness of description is no more proof of synonymy than of validity.

Taking into account, therefore, all the specific characteristics described above it seems reasonable to conclude that *A. latus* is a valid species, now that both sexes are known.

Incidentally it is worthy of note that figure 108 bears the signature of J. H. Emerton, the locality Quohog Bay, and date September 3, 1873, and "drawn from life." In all probability this figure was drawn for the 1873 description from one of the original type specimens. Quohog Bay lies between Marthas Vineyard and Chappaquiddick Island and the brackish-water pond from which the present specimens

were taken open into it. Hence these two males and two females came from exactly the same locality as the original type females. It is also worthy of note that all the specimens of both sexes were caught swimming freely in the tow.

ARGULUS MEGALOPS SPINOSUS, new variety

PLATE 26, FIGURES 95–104

Dr. Frits Johansen obtained 32 specimens, including both sexes, from the outside surface of an eel-backed flounder (*Liopsetta putnami*) at Cape Tormentine, New Brunswick, in the Gulf of St. Lawrence. The male allotype and female holotype are U.S.N.M. No. 60460. Forty specimens, also including both sexes, were taken from the skin of the long-spined sculpin (*Acanthocottus octodecimspinosus*) in the Gulf of St. Lawrence.

Female.—Carapace elliptical, the length to the breadth as 5 to 4 and to the length of the entire body as 5 to 8. Posterior sinus broadly triangular and shallow, posterior lobes reaching the center of the third segment. Abdomen broadly elliptical, the width to the length as 11 to 13; anal sinus narrow and short, caudal rami basal. Fourth thoracic segment as wide as the third, with broadly rounded lobes at its posterior corners.

Second segment of the first antenna with a stout curved spine on its anterior margin, a straight spine on the ventral surface near the posterior margin and a large and strongly curved lateral claw. The middle segment of the terminal portion of the antenna has two large spines at its distal end and the terminal segment is tipped with three spines. The basal segment of the second antenna has a very stout and blunt spine on its ventral surface close to the proximal end. The second, third, and fourth segments diminish rapidly in length, the fourth a third as long as the second. All four segments are girdled with long and slender spines, numbering respectively eleven, six, four, and three. The supporting rods in the margins of the sucking disks are each made up of six segments nested one within another, the basal one twice as long as the others. The maxilliped is stout and fairly spiny on its ventral surface. The swimming legs are practically identical with those of the regular female of the species and are without flagella.

Male.—Carapace ovate, longer than wide, with a deep sinus on each lateral margin opposite the compound eyes forming a prominent shoulder.[9] Posterior sinus enlarged at its base, posterior lobes reach-

[9] The male of *Argulus dactylopteri* Thorell (1865, p. 609, pl. 16) shows an even more prominent shoulder.

ing the fourth thoracic segment. Abdomen elliptical, three-fifths longer than wide with a very shallow posterior sinus, the caudal rami basal. The testes are elongate elliptical and reach the entire length of the abdomen.

The antennae, mouth parts, and first two pairs of legs are like those of the female. On the basal segment of the third legs in place of the thumblike process of the regular male is a slender, 3-segmented process which extends along the side of the second joint parallel with the axis of the leg instead of standing out at right angles to it. On the basal segment of the fourth leg at the anterior distal corner is a peg that is pointed instead of spherical and apparently 2-jointed. Total length of female, 5.8 mm.; of male, 4 mm.

Remarks.—This new variety is distinguished chiefly by the heavy spinous armature of the antennae and mouth parts of the female and by the prominent carapace shoulders and the sex armature of the basipods of the third and fourth legs in the male.

ARGULUS ROTUNDUS, new species

PLATE 27, FIGURES 116–122

The type, a single female, U.S.N.M. No. 78901, was obtained from an unknown fish in the Gulf of Mexico in May 1915.

Female.—Carapace circular, about as wide as long; posterior lobes elongate and coiled around behind the thorax overlapping the abdomen. Posterior sinus wide and deep reaching the center of the carapace. Respiratory area consisting of a long outer tract curved to follow the outline of the carapace and a very much smaller ovate inner area set into the inner margin of the larger area near its anterior end. The smaller area is at right angles to the larger one, its pointed end inward. Abdomen wider than long, its posterior sinus not reaching the center, the sides of the sinus overlapping so that the only opening is at the base where the caudal rami are attached and they are more or less invisible in dorsal view.

In the first antennae the basal segment has a small blunt spine at the proximal posterior corner and a still smaller pointed process at the anterior distal corner. The second segment has a smooth anterior margin without any indication of a spine or knob and its ventral surface is likewise unbroken. The lateral claw is stout and strongly curved and the terminal portion of the antenna is 2-segmented and reaches just beyond the curve of the claw. The second antennae are slender and 4-segmented, with a spine on the basal segment and an elongate second segment. The sucking cups are large and so close together that they almost touch on the midline. The supporting rods in the margins are slender, each made up of 11 segments, of which the 2 basal ones are a trifle larger than the

others. The 2 distal segments are reduced to mere rods curved into a half circle and the margin of the cup, fringed with hairs, is indented opposite each rod. The maxillipeds are stout with a wide basal plate having a large raised area covered with hairs. The three projections on the posterior margin of the plate are flat laminae squarely truncated at their tips, the distal one nearly as wide as the other two combined, the middle one narrow. The first and second legs carry normal flagella; in the fourth legs each basipod segment has a laminate pad on its posterior margin. The one on the proximal segment is almost squarely truncated, the one on the distal segment is inclined outward and broadly rounded. All the legs are invisible in dorsal view. Total length, 10 mm. Carapace width, 9.25 mm.

Remarks.—This large *Argulus* has an almost perfectly circular outline, the carapace covering everything except a part of the thorax in the posterior sinus. The respiratory areas, the supporting ribs of the sucking cups, and the posterior pads on the basipods of the fourth legs furnish the best characteristics for identification.

ARGULUS MELANOSTICTUS Wilson

PLATE 25, FIGURES 89–94

Argulus melanostictus WILSON, 1935, p. 776, pl. 25, figs. 1–4.

A single female, U.S.N.M. No. 60504, was obtained by Dr. H. M. Smith in plankton from the Gulf of Thailand. The host is unknown. As this locality is separated by the entire width of the Pacific Ocean from Monterey Bay on the coast of California, where the type specimens were found, and as this female differs from the types in some particulars it is here described and figured.

Female.—Carapace cordate, considerably narrowed anteriorly, slightly longer than wide, the posterior lobes narrowly rounded, strongly divergent and not quite reaching the fourth thoracic segment. Cephalic area a little wider than long and projecting anteriorly; compound eyes of medium size, far forward and well separated. The entire dorsal surface of the carapace, the thorax, and the abdomen are covered with small spots jet black in color. These spots are circular or slightly elliptical, vary considerably in size, and are not arranged in any definite pattern (fig. 94). The first and second segments of the thorax are equal in length, the third is longer and the fourth shorter. The abdomen is two and a half times as long as wide, the anal sinus extends beyond the center and the posterior lobes are very narrow and acute. The caudal rami are very minute and basal and partly concealed in dorsal view. The entire integument of the abdomen, dorsal, lateral, and ventral, is raised into minute irregular knobs like pebbled leather, which gives the wavy outline noticeable in the figure.

In the first antennae there is a well-developed claw on the anterior margin of the second segment, the lateral claw is long and slender and its curve nearly reaches the tip of the flagellum, which is 3-segmented. The second antenna is 4-segmented, the basal segment a little longer than the other three segments combined and armed on its ventral surface with a large acute spine. The sucking disks are small, well separated, and removed a considerable distance behind the compound eyes. The supporting rods are very irregular, each made up of about 35 segments more or less imbricated, of different lengths and different curvatures, no two alike but showing a general tendency toward a uniform taper distally (fig. 91). The maxilliped corresponds well with the California specimens and is distinguished chiefly by the finger processes with which it is tipped (fig. 93). The first two pairs of legs have flagella and the fourth basipod has a boot-shaped posterior lamella. Length, 8 mm.

Remarks.—The description of this Thailand specimen is of interest chiefly to show the differences that may occur within the same species in specimens living in widely separated localities. The supporting rods of the sucking disks are worthy of special comment for the variations they exhibit. In the original type specimens from California each was made up of 19 to 21 crescentic disks regular in outline, uniformly imbricated, and tapered distally. In this specimen from the other side of the Pacific the number of segments jumps to 30 or more and the only regularity left is in the distal tapering, the form and the imbrication becomingly extremely irregular.

ARGULUS TRILINEATUS Wilson

PLATE 25, FIGURES 79–88

Argulus trilineata WILSON, 1904, p. 651, figs. 34–38.
Argulus japonicus MEEHEAN, 1940, p. 494, fig. 32.

This species was founded upon a single female from a goldfish from Macon, Ga., and another single female was obtained from a goldfish at Henderson, Ky., in 1914. These are the only specimens reported up to June 1937, when 6 females and 6 males were taken by Dr. Josiah Bridge from goldfish at Takoma Park, Md. The males, the allotypes, U.S.N.M. No. 78900, are the first males to be collected.

Male.—Carapace elliptical, a little shorter than wide and reaching just beyond the anterior margin of the fourth thoracic segment. The cephalic area projects considerably from the anterior margin; the compound eyes are large, far forward, and well separated. The posterior sinus is quite narrow and only about a fourth of the carapace length. The central longitudinal ribs extend to the frontal margin of the head and are not branched. The respiratory areas are like

those of the female, a small elliptical anterior area and a large posterior area slightly curved. The abdomen is spindle-shaped, one-half longer than wide; the posterior sinus does not reach the center and the posterior lobes are bluntly rounded. The base of the sinus is angular and the caudal rami are subbasal, attached to the sides of the angle a short distance from the extreme base. (See fig. 80.)

The first and second antennae are like those of the female; the supporting rods in the margins of the sucking disks are stout and 4-jointed. The basal segment is twice as long as any of the others and is tapered proximally; the other segments diminish in size distally. The segments of the maxillipeds are much shorter than in the female and the end segment is divided lengthwise, the anterior portion ending in a finger process, the posterior portion in a curved claw. The first and second legs have no flagella; in the second legs the proximal basipod segment has a rounded knob at either end extending backward from the posterior margin and the two knobs are connected by a concave membrane. In the third legs the distal basipod segment has a large inner receptacle that opens on the posterior surface and can be closed by an external flap. The proximal basipod segment of the fourth leg has a rounded lobe on its posterior margin; the distal basipod segment has an acutely pointed peg at its distal anterior corner, and its posterior margin is fringed with long hairs. Total length, 3.25 mm. Carapace, 2.15 mm. long, 1.95 mm. wide.

Remarks.—With reference to this species Meehean said (1940, p. 468): "Specimens of *A. japonicus* collected by Dr. Pearse in Japan and those sent me from that country proved to be identical with *A. trilineatus*, thus invalidating another species." The fortunate discovery of the male suffices to distinguish *trilineatus* from *japonicus*. A fine lot of specimens of *japonicus*, including both sexes, was taken from goldfish at Tokyo, Japan, and sent to the National Museum. For the sake of comparison with the present species these are fully described on p. 559 and figured. If the two sets of figures here presented are compared in detail it will be found that they are not identical, as Meehean claimed, but enough differences can easily be found to make both species valid. Attention is called particularly to the pattern of the dorsal grooves of the carapace, to the length of the posterior lobes, to the details of the first and second antennae, especially the latter, to the supporting rods of the sucking disks, to the maxillipeds, and to the caudal rami. The sum total of these differences is more than sufficient to overcome any similarity that may be found in the pattern of the respiratory areas.

ARGULUS BIRAMOSUS Bere

PLATE 20, FIGURES 2, 4, 6

Argulus biramosus BERE, 1931, p. 428, pl. 9, figs. 1–7.
Argulus appendiculosus MEEHEAN, 1940, p. 512 (part).

There is considerable similarity between *biramosus* and *appendiculosus* in the respiratory areas and supporting rods (figs. 3 and 4), but there is no real identity, as Meehean claims. There are many differences in the structural characters of the various appendages. The second segment of the first antenna in *appendiculosus* is armed with a spine on the ventral surface near the proximal end and two transverse ridges at the distal end across the base of the lateral claw (fig. 1). Both spine and ridges are absent in *biramosus* (fig. 2). The flagellum is biramose in both species but it differs in shape and armature. The second antennae are 4-segmented in *appendiculosus*, the basal segment without setae. In *biramosus* they are 5-segmented, every segment armed with setae.

Meehean's description of the abdomen as spindle-shaped applies better to *biramosus* than to *appendiculosus*, where it is scarcely narrowed at all anteriorly; cordate would be a more accurate term. In the latter species the caudal rami are lateral, close to the base of the posterior sinus, and practically invisible dorsally. In *biramosus* they are farther from the base, stand out prominently in dorsal view, are divergent, very much larger, and truncate at their tips. Meehean's description fits them admirably but does not apply at all to the caudal rami of *appendiculosus* (figs. 5, 6).

These differences may not be enough fully to establish *biramosus* as a valid species, but they are more than enough to question the validity of this species as a synonym of *appendiculosus*. Unfortunately, Dr. Bere did not have a male in material that was collected at Trout Lake, Wis., and one must be examined before synonymy can be finally settled. In the meantime *Argulus biramosus* should stand.

ARGULUS CANADENSIS Wilson

PLATE 20, FIGURES 8, 10, 12, 14

Argulus canadensis WILSON, 1916, p. 348, pl. 60, figs. 1–6; 1936c, p. 355, figs. 1–9.
Argulus stizostethii MEEHEAN, 1940, p. 479 (part).

Despite the statement that this species is the same as *stizostethii* Kellicott, Meehean (1940, p. 480) admits "a slight variation in size and shape of body and some structures." The difference in size applies to nearly all the specimens and the variation in shape is seen especially in the cephalic area of the carapace, the position of the compound eyes, the formation by the dorsal ribs of the carapace of a definite shoulder on either side of the cephalic area in *canadensis* and its complete absence in *stizostethii*, and in the position of the cau-

dal rami. The testimony of the structural characters of the appendages is even more decisive. Figures 7 and 8 show the two pairs of antennae, the spines on the basal segments in *stizostethii* large, long, and pointed (fig. 7), those in *canadensis* smaller, short, and blunt (fig. 8). Figures 9 and 10 show the supporting rods of the two species, the segments in *canadensis* (fig. 10) doubly imbricated and strongly tapered, those in *stizostethii* (fig. 9) simply imbricated and much less tapered. Figures 11 to 14 show the accessory sexual characters of the third and fourth legs of the respective males. The prominent curved spine on the posterior margin of the third basipod in *canadensis* (fig. 12) and the two knobs at the anterior distal corner of the fourth basipod (fig. 14) contrast strongly with what is found in the same localities in *stizostethii*. Such a comparison can prove only that *canadensis* is a perfectly valid species and not a synonym of *stizostethii*. In support of this statement it may be noted that the hosts of *canadensis* belong almost exclusively to fish of the salmon and trout families while the hosts of *stizostethii* are found in the sauger and pike families.

ARGULUS NIGER Wilson

PLATE 20, FIGURES 15, 17

Argulus niger WILSON, 1902, p. 714, pl. 18, figs. 42–45.
Argulus pugettensis MEEHEAN, 1940, p. 487 (part).

Meehean expresses the opinion (1940, p. 467) that "The male of *A. niger* has never been described, since it is the same as *pugettensis* except that the former is very dark, as its name indicates." If the lack of a male is to be taken as evidence that the female must become the synonym of some other species whose male is known, the number of copepod species would be greatly diminished. The same statement is made by Meehean (1940, p. 468) in reference to *A. latus* Smith, but the male of that species was found among the specimens here identified and is fully described on p. 560. There is a similar chance that the male of *niger* will be found some day among parasitic copepods from the Pacific coast.

Following his redescription of *pugettensis* Meehean remarks (1940, p. 489): "As far as can be determined *niger* is identical in every respect." Meehean himself notes the difference in color, which in the present instance is an exceptional one. Ordinarily the color of preserved specimens is not worth recording although in the living animal it presents one of the most important specific distinctions; but black is an exceedingly rare color in parasitic copepods and may well serve as the first character to separate *niger* from *pugettensis*. Figures 15 and 16 show the antennae of the two species and figures 17 and 18 the maxillipeds. A cursory examination of these figures will be sufficient

to prove that the species cannot be synonyms and that there is no need of waiting for the discovery of the *niger* male. The relative length of the flagellum in the antenna and of the second segment in the second antenna and the comparative size and armature of the end segment in the maxilliped are especially noticeable.

ARGULUS VARIANS Bere

PLATE 21, FIGURES 19, 21; PLATE 26, FIGURES 105–107

Argulus varians BERE, 1936, p. 579, pl. 1, figs. 11–16.
Argulus megalops MEEHEAN, 1940, p. 492 (part).

Although Meehean claims only that *varians* is "similar to *megalops* except for the great variation in the size of the carapace" (1940, p. 468), he records it as a synonym. Dr. Bere's species was established in the laboratory of the present author and her specimens were carefully examined before being accredited as new. The following considerations led to the separation of *varians* from *megalops* and these still seem sufficient.

The size and shape of the respiratory areas are shown in figures 19 and 20, and while they are similar they are by no means identical. Figures 21 and 22 show the supporting rods in the sucking cups. In *varians* each is made up of four segments longer than wide, subrectangular, the basal one as long as the other three. In *megalops* each rod is made up of ten segments wider than long and strongly imbricated. The second antennae are 5-segmented and as long as the first pair in *varians;* they are only 4-segmented in *megalops* but are nearly twice as long as the first pair. The ventral surface of the maxillipeds and the basal plate in *varians* are covered with scales whose distal margins are divided into four to seven sharp points. In *megalops* there are no scales, only minute spines. In *varians* the seminal receptacles are close to the anterior margin of the abdomen and almost touch each other on the midline. In *megalops* they are larger, farther from the anterior margin, and well separated. All these characteristics are opposed to synonymy with the similarity in the respiratory areas the only point in its favor. The balance of evidence therefore is decidedly against synonymy and *varians* must be restored to validity.

ARGULUS MACULOSUS Wilson

PLATE 21, FIGURES 24, 26, 28, 30

Argulus maculosus WILSON, 1902, p. 715, pl. 19, figs. 46–50, pl. 26, fig. 82; 1907b, p. 416, pl. 31, figs. 15–22. (Not *Argulus maculosus* Meehean, 1940, p. 507.)

Meehean (1940, p. 468) stated that he was compelled to redescribe this species because no specimens could be found "to match the

original description." However, he did not redescribe the original material, but substituted new types, a new description, and new figures, and should have given it a new name; *Argulus diversus* is here proposed, p. 572. His species, therefore, cannot be entered above under the original name; neither should the above references appear over his description of *maculosus* as that is an entirely different species.

Meehean found a vial containing two males and three females in the National Museum collection correctly labeled *A. maculosus*. On examination he found the respiratory areas of these five specimens similar to those of *A. americanus* and he identified them with that species. However, these specimens are not *americanus* as is plainly shown below. Even if they had been *americanus* the name *maculosus* had the right of priority and the former should have become the synonym. The two species were established in the same publication (Wilson, 1902), *maculosus* on p. 715 and *americanus* on p. 718.

Meehean (1940, p. 468) apparently believed that this species was established on the basis of color, but in the original description the color was expressly stated to be that of alcoholic specimens, which would nullify any specific value. As might have been easily inferred the color was introduced solely to explain the origin of the specific name.

The first proof of the validity of both species is found in the shape and proportions of the body regions. In *maculosus* the carapace falls considerably short of the anterior margin of the abdomen and the inner margins of the posterior lobes are parallel and separated enough to disclose the entire thorax. In *americanus* the carapace reaches the center of the abdomen and its posterior lobes are turned inward and overlap on the midline, entirely concealing the thorax. In *maculosus* the abdomen is a fourth as wide as the carapace and as long as it is wide. In *americanus* the abdomen is half as wide as the carapace and its width is 60 percent greater than its length. In *maculosus* the caudal rami are definitely subterminal; in *americanus* they are more nearly terminal.

The anterior margin of the first antenna is armed with a stout claw in *americanus* (fig. 25) and the flagellum projects far beyond the curve of the lateral claw. In *maculosus* (fig. 26) the anterior margin is smooth and the flagellum does not reach the curve of the lateral claw. The second antenna is 4-segmented in *americanus* and reaches far beyond the tip of the first antenna. In *maculosus* it is 5-segmented and does not quite reach the tip of the first antenna. Figures 27 and 28 show the supporting ribs of the sucking cups in the two species. In each they are 2-segmented but the segments themselves differ radically in length and shape. The ventral surface of the maxillipeds in

americanus and the boss on the basal plate are armed with stout scale-like spines but in *maculosus* the spines are small and simple and there is no boss on the basal plate.

The respiratory areas in these two species are so nearly alike yet differ so much among themselves that sufficient search might yield a specimen of each species in which these areas could be regarded as identical. During the search it would become evident that the areas show definite tendencies toward the two forms in figures 23 and 24. Figures 29 and 30 show the accessory sex characters in the last three pairs of legs in the two males. Without giving a detailed comparison it can be seen readily that nowhere do they correspond; that everywhere there are marked differences. Finally it is worthy of note that newly hatched larvae of these two species have been obtained from eggs laid in aquaria in the laboratory. These larvae have been fully described and figured (Wilson, 1907b, p. 416, pl. 31, figs. 15–32, *maculosus*, and 1904, p. 639, figs. 16–21, *americanus*). The contrast between the respiratory areas in these two larvae is especially interesting, as it strongly offsets whatever similarity may be found in the adults.

There is thus a single characteristic in which more or less similarity might be claimed but everywhere else there is such overwhelming dissimilarity as definitely to separate the species and make them both valid.

ARGULUS DIVERSUS,[10] new name

Argulus maculosus MEEHEAN, 1940, p. 507, fig. 40, preoccupied.

The characters given in the key on p. 579 distinguish this species from its nearest relatives.

ARGULUS PAULENSIS Wilson

PLATE 21, FIGURES 31–33

Argulus paulensis WILSON, 1924, p. 4, pl. 1, figs. 1–5.
Argulus salminei MEEHEAN, 1940, p. 502 (part).

Although admitting that the National Museum collection contained no specimen of *salminei* with which to compare this species, Meehean (1940, p. 468) nevertheless decided that the two species were "apparently the same" and recorded *paulensis* as an actual synonym of *salminei*. The types of both sexes of these species were reexamined and the following details are now added to the original description:

Female.—Abdomen longer than wide with broadly rounded posterior lobes, which are fringed with short hairs. The posterior sinus is a quarter of the abdomen length and the caudal rami are curved

[10] *diversus*, different.

and attached to the sides of the sinus close to its base (fig. 33). The seminal receptacles are unique in that they are not circular as in most species but irregularly ovate. Each is so large that it nearly fills the entire anterior corner of the abdomen and is surrounded with a fleecy packing that looks like cotton. This packing is snow white and stretches back along the midline to the base of the posterior sinus. These abdominal details are sufficient to separate this from all other known species.

Male.—The respiratory areas are shown in figure 31. The smaller one has an elongate ovate form, the smaller end turned forward, and fits into an invagination on the inner side of the larger one. The latter is enlarged behind the invagination and narrowed in front of it, with rounded ends. The abdomen is relatively much larger than in the female and the testes, like the seminal receptacles in the female, are exceptionally large and fill nearly all the abdomen in front of the posterior sinus. The caudal rami are curved and lateral. In the original description of this species in the reference given above it was clearly distinguished from *salminei.* This distinction still holds and with the addition of the details here given makes this species undeniably valid. As stated there the two males found by Thiele in the Copenhagen Museum and referred to *salminei* do not agree with Krøyer's type male but do agree fully with this male *paulensis* and evidently belong here.

ARGULUS NATTERERI Heller

PLATE 24, FIGURES 74–78

Argulus mattereri HELLER, 1857, p. 103, pl. 2, figs. 4–12.—KRØYER, 1863, pp. 97, 103, pl. 1, fig. 2a–d.—THIELE, 1904, p. 23, pl. 7, figs. 43–52.
Argulus salminei MEEHEAN, 1940, p. 502 (part).

Two females originally identified as belonging to this species were declared by Meehean (1940, p. 503) to be "identical with *A. paulensis*," but he placed in the vial containing them an autographed label that read "identified as *A. salminei.*" In furtherance of this last statement the figure of the respiratory areas in Meehean's species *salminei* was taken from one of these females. (See figure 74.) The color of these preserved females is dark brown, the respiratory areas considerably darker than the carapace. The color of the preserved *paulensis* specimens is snow white and they are only half as large as the *nattereri* females. The first and second antennae correspond in every detail with the figures given by Thiele for *nattereri* with not enough difference in the anterior protuberance of the first pair to be worthy of mention (Meehean, 1940, p. 503). In one female all the teeth on the basal plate of the maxilliped were short and broad but in the other female (fig. 77) only the central tooth was short while the

other two were long and narrow. The supporting ribs of the sucking cups have 16 segments, 125 percent more than the 7 reported for *salminei* and 60 percent more than in *paulensis*. The respiratory areas of *paulensis* (fig. 31) and *nattereri* (fig. 74) are so radically different that the two species could not possibly be synonyms. The caudal rami of *paulensis* (fig. 33) are curved and lateral, those of *nattereri* (fig. 78) are straight and basal. For the present, therefore, the three species, *paulensis*, *nattereri*, and *salminei* must be regarded as equally valid, awaiting the discovery of the male of *nattereri* and the reexamination of both sexes of *salminei* with especial reference to the respiratory areas and supporting rods.

ARGULUS SALMINEI Krøyer

Argulus salminei Krøyer, 1863, pp. 89, 102, pl. 1, fig. 1a–f.—Wilson, 1902, p. 720, pl. 22, fig. 64. (Not *Argulus salminei* Meehean, 1940, p. 502, fig. 57; see under *A. nattereri* and *A. paulensis*.)

The National Museum collection contains a single example of this species, identified and forwarded by F. Silvestri, of Buenos Aires, Argentina. This sample has lost all its appendages and the body is mutilated and distorted, hence no specific characters are revealed. Therefore, the statement made by Meehean (1940, p. 468) that no specimen of the species was available may be regarded as virtually correct.

In spite of this statement, however, Meehean has published a detailed description of both sexes accompanied by original figures. The description could be compiled easily from existing literature without a specimen but not so the figures. Since no suitable specimen of *salminei* was available the figures must have been taken from specimens declared to be synonyms of *salminei*. The accessory sex characters that Meehean gives correspond exactly with those of a *paulensis* male; the respiratory areas are identical with those of a *nattereri* female and the supporting ribs are those of the *paulensis* female. Meehean's description of necessity corresponds with his figures, and since both *paulensis* and *nattereri* are shown in the present paper to be valid species the result is that his species becomes a synthesis of the characters of two species, neither of which is the real *salminei*, and must be canceled.

It would seem as if Thiele was largely responsible for this confusion of species. He found two male specimens of the genus *Argulus* in the Copenhagen Museum unaccompanied by a female. For some reason he placed them in the species *salminei* although they did not agree at all with Krøyer's type male of that species. However, they do agree fully with the male of *paulensis*, a species established 20 years later. This male was associated with two females on the same fish and they

may safely be regarded as the two sexes of *paulensis*. Thus we have three males just alike and one of them is proved to be the male of *paulensis* through association with two females. The only sensible disposal of the other two, considering the fact that they do not agree with the type male of *salminei*, is to transfer them to the species *paulensis*, with the male of which they do agree, and to conclude that Thiele was mistaken in his identification.

NOTE ON THE KEY TO THE SPECIES OF ARGULUS

The key to the species of *Argulus* published in Meehean's paper (1940, pp. 475–479) is here used as a basis for a new key. The key is based on only the species of which material for examination was available in the collections of the United States National Museum (*cf.* p. 552, footnote 8, and p. 576, footnote 11). In it are included eight species that Meehean regarded as synonyms, four new species, and one new name. Using the characters for identification that appear in the key, the eight species that Meehean took to be synonyms are found to have validity as creditable as any of the species included.

Meehean's key has real worth and is of great value in determining the species of *Argulus*. However, it placed excessive value upon the respiratory areas and the supporting ribs of the suction cups. The insertion of the eight species shows how easily the real validity can be established by carrying the analysis to further details without impairing the testimony of the areas and ribs. A key that will allow this may be depended upon for the reception of new species that may appear in the future.

In distinguishing *A. bicolor* from *A. fuscus* in the original key *bicolor* shows as much widening in the posterior portion of the larger respiratory areas as is seen in *fuscus*. Dr. Bere shows no widening in the latter species.

The species *A. salminei* Meehean has been shown to combine both *A. nattereri* and *A. paulensis*, which are valid species, and as sufficient structural details of Krøyer's *salminei* are not available for want of actual specimens this species has not been included in this key.

A new name, *diversus*, is given to Meehean's *maculosus*, which was preoccupied.

A. biramosus Bere (p. 568) is not included in the key. No male has been discovered and without males the species cannot be fully characterized. It may be questioned that this species is identical with *appendiculosus*, as Meehean believes. In the type specimen of *appendiculosus* the dorsal ribs of the carapace were not branched anteriorly.

An asterisk following a specific name indicates that this actual species did not appear in the original key published by Meehean.

KEY TO THE SPECIES OF ARGULUS IN THE UNITED STATES NATIONAL MUSEUM [11]

a^1. Anterior respiratory area prolonged laterally around posterior one (club-shaped).

b^1. Teeth of basal plate of second maxillae sharp and well separated; supporting ribs of suction cups made up of 12 to 15 singly imbricated segments; flagellum of first antenna with 2 equal segments; no flagella on legs; distal segment of third basipod in male with many small knobs on ventral surface but without posterior spine; fourth basipod with a single spherical peg ---------- **stizostethii**

b^2. Teeth of basal plate sharp and well separated; supporting ribs of suction cups made up of 10 to 12 doubly imbricated segments; no flagella on legs; basal segment of flagellum on first antenna five times as long as distal segment; third basipod in male without knobs but with posterior curved spine; fourth basipod with 2 pegs, the outer one bent at right angles ---------- **canadensis*** (p. 568)

b^3. Teeth of basal plate blunt, close together; supporting ribs of suction cups made up of 4 to 6 segments; flagella present on legs; third basipod with ventral suckers; fourth basipod without a peg in male; respiratory areas very narrow ---------- **siamensis**

a^2. Smaller respiratory area anterior, mesial, or in an anteromesial notch of larger area.

b^1. Entire smaller respiratory area anterior to larger one.

c^1. Teeth on maxillary plate sharp, distal one more widely separated than other two; ribs of suction cups composed of 10 to 12 shorter segments and 1 longer one; carapace just reaching fourth segment, which has rounded corners overlapping abdomen; third basipod in male with posterior swelling; fourth basipod with 2 blunt anterior processes and a spherical peg ---------- **alosae**

c^2. Teeth on maxillary plate blunt and close together; ribs of suction cups with 7 to 8 beadlike segments not imbricated; fourth segment without overlapping corners; carapace reaching abdomen; basipod of second leg in male with 2 posterior processes, of third leg with posterior swelling, of fourth leg with an acute peg ---------- **lunatus*** (p. 557)

c^3. Teeth on maxillary plate sharp and curved dorsally; ribs of suction cups made up of 1 long basal and 6 to 7 short terminal segments flattened but not imbricated; second and third male basipods not modified, fourth with a spherical peg at anterior center of distal segment. **longicaudatus*** (p. 555)

c^4. Basal plate of maxillae lobed or with slender blunt teeth.

d^1. Maxillary teeth blunt but plate not lobed.

e^1. Ribs of suction cups made up of rods.

f^1. Ribs composed of 3 rods; knob or hook lacking on anterior margin of first antennae; lobe of fourth leg boot-shaped, toe extending to or beyond edge of abdomen; whole body circular; anterior respiratory area minute, posterior very large ---- **indicus** (p. 552)

f^2. Ribs composed of 4 to 6 rods; anterior hook present on first antennae; lobe of fourth leg large, semicircular, without a heel;

---

[11] Two species overlooked in making up this key are *A. cubensis* Wilson and *A. rhamdiae* Wilson (*cf.* footnote p. 552.)

body one-fourth longer than wide; anterior respiratory area as wide as posterior but very much shorter ---------- flavescens

e^2. Ribs of suction cups made up of imbricated plates with or without a long basal segment.

f^1. Ribs of suction cups made up of imbricated plates; postantennal spine broad and blunt.

g^1. Imbricated plates 30 or more; knob present on anterior margin of first antennae; maxillae slender -- melanostictus (p. 565)

g^2. Imbricated plates 15 to 20; carapace reaching abdomen; anterior hook present on anterior margin of first antennae.

h^1. Flagella present; basal maxillary plate with a boss covered with spines; end segment of maxilliped half as large as penultimate segment; tipped with 3 sharp claws; second antenna 5-segmented, second segment as long as third ---------- pugettensis

h^2. Flagella present; maxillipeds exceptionally stout, basal plate without a boss, end segment 3 times as large as penultimate segment; second antennae 4-segmented, third segment 9 times as long as second ---------- niger* (p. 569)

h^3. No flagella; maxillipeds normal size; proximal tooth on basal plate widened; respiratory areas nearly equal in size; supporting ribs made up of 19 tiny segments; segments of second antennae equal ---------- floridensis

f^2. Ribs of suction cups made up of long basal segment and imbricated plates.

g^1. Swimming legs without flagella.

h^1. Respiratory areas small and widely separated; basal segment of supporting ribs narrow and elongate; posterior lobe of fourth leg somewhat bilobed; knob on anterior margin of first antenna ---------- borealis

h^2. Respiratory areas normal, one large, one small.

i^1. Spines on basal maxillary plate alike; posterior respiratory area regular; supporting ribs made up of 1 long and 9 imbricated segments; posterior lobe on fourth leg boot-shaped; basipod of third leg in male with curved spine at anterior corner; basipod of fourth leg with spherical peg ---------- megalops (p. 563)

i^2. Spines on basal maxillary plate alike; posterior respiratory area symmetrical; supporting ribs made up of 1 long basal and 3 distal segments not imbricated; lobe on fourth leg without a toe; second male basipod with 2 posterior processes; fourth basipod with conical peg. trilineatus* (p. 566)

i^3. Spines on basal maxillary plate alike; posterior respiratory area symmetrical; ribs of suction cups made up of 4 quadrangular segments; ventral surface of maxilliped covered with scales ---------- varians* (p. 570)

i^4. Spines on basal maxillary plate unlike, lateral one blunt, the others more pointed; anal sinus deep.

j^1. Suction cups occupying almost full width of carapace; supporting ribs made up of 6 to 10 imbricated plates and a rectangular basal segment; larger respiratory area widened posteriorly ---------- bicolor

j^2. Suction cups normal size; supporting ribs made up in female of 12 to 14 imbricated plates with a rectangular basal segment; larger respiratory area same width throughout ---------- **fuscus**

g^2. Swimming legs with flagella.

h^1. Anterior hook on first antenna, broad spine at base and broad postantennal spine; ventral surface of maxilliped with spinous pads and boss on basal plate ---- **pugettensis.**

h^2. Anterior knob on first antenna; no postantennal spine; no spinous pads on maxilliped but boss on basal plate; dorsal ribs of carapace branched anteriorly ---- **japonicus** (p. 558)

d^2. Basal maxillary plate lobed.

e^1. Lobes of maxillary plate truncate; anterior hook on first antennae; ribs of suction cups made up of rods.

f^1. Lobes of maxillary plate parallel, squarely truncate; ribs of suction cups made up of 3 rods; posterior respiratory area deeply notched on inner margin, posterior end much wider than anterior. **laticauda**

f^2. Lobes of maxillary plate very divergent, truncate in female, rounded in male; ribs of suction cups with 4 or 5 rods; posterior respiratory area not notched and same width throughout. **reticulatus**

e^2 Lobes of maxillary plate not truncate.

f^1. Postmaxillary spines missing; proximal lobe of maxillary plate more widely separated than the other two; ribs of suction cups made up of 16 to 18 segments singly imbricated; abdomen of male 3 times as long as wide, testes 10 times as long as wide; third and fourth basipods in the male modified -------- **funduli**

f^2. Postmaxillary spines missing; neither lobes nor teeth on the basal maxillary plate; ribs of suction cups made up of 18 to 19 segments doubly imbricated; abdomen of male one-eighth longer than wide; testes 3 times as long as wide; male legs not modified ---------- **latus*** (p. 560)

f^3. Postmaxillary spines missing; teeth on basal maxillary plate long and evenly spaced; ribs of suction cups made up of 14 to 15 segments not imbricated; lobes of abdomen fringed with short hairs ---------- **nattereri*** (p. 573)

f^4. Two pairs of postmaxillary spines present; lobes of basal maxillary plate broad, truncate; ribs of suction cups made up of 2 rods shaped like a cane with a curved handle, handle of both rods proximal; anterior respiratory area small, triangular. **violaceus**

b^2. Smaller respiratory area mesial to larger or in an anteromesial notch of latter.

c^1. Spine present at base of first antenna.

d^1. Three postantennal spines in a row on each side of midline.

e^1. Smaller respiratory area anteromesial; ribs of suction cups 2-segmented, distal segment a third as long as basal, blunt; anterior peg on fourth male basipod conical, posterior process broadly rounded ---------- **americanus**

e^2. Smaller respiratory area more mesial; ribs of suction cups 2-segmented, distal segment longer than basal, acuminate; anterior peg on fourth male basipod spherical, posterior process acute. **maculosus*** (p. 570)

e^3. Smaller respiratory area entirely mesial; ribs of suction cups 6-segmented, basal segment longest; anterior peg on fourth male basipod conical, posterior process narrowly rounded. **diversus**[12] (p. 572)

e^4. Smaller respiratory area entirely mesial; ribs of suction cups 3- or 4-segmented, basal segment narrowest; anterior peg on fourth male basipod fingerlike, posterior process with heel and acute toe ---------- **versicolor**

d^2. Only 2 postantennal spines on each side; ribs of suction sups made up of 5 to 8 rods diminishing in length distally; anterior peg of fourth male basipod conical; posterior processes on both basipod segments, without heels ---------- **mississippiensis**

d^3. No postantennal spines; lobes of basal maxillary plate close together, laminate and truncate, the distal one widest, the central one narrowest; ribs of suction cups made up of 11 beadlike segments, the 2 distal ones imperfect ---------- **rotundus*** (p. 564)

c^2. No spine at base of first antenna.

d^1. Basal maxillary plate lobed or with slender blunt teeth; no spine on ventral surface of first antenna, or at base of first or second antennae.

e^1. Basal maxillary plate with 2 to 4 lobes, usually 3; postmaxillary spines absent; anterior knob present on first antennae; ribs of suction cups made up of 7 to 9 short rods ---------- **catostomi**

e^2. Basal maxillary plate with 3 blunt teeth; anterior knob on first antennae rudimentary; tip of flagellum biramose; ribs of suction cups made up of 2 long rods; posterior lobe of fourth male basipod very large ---------- **appendiculosus**

d^2. Basal maxillary plate with very sharp teeth; no spine at base of first antenna; ribs of suction cups made up of rods.

e^1. Ribs of suction cups with 8 or 9 rods; lateral hook of first antenna short, not reaching tip of flagellum; abdomen nearly half as wide as carapace ---------- **lepidostei**

e^2. Ribs of suction cups with 12 to 18 short rods; abdomen two-fifths of carapace width with lateral projections at anterior corners in male; protuberances at distal end of first endopod segment of third and fourth legs in male ---------- **nobilis**

e^3. Ribs of suction cups made up of a long basal and 5 or 6 short distal rods; first 3 thoracic segments with narrow dorsal pads on their posterior margins; abdomen one-fifth as wide as carapace; no protuberances on legs of male ---------- **intectus*** (p. 553)

d^3. Basal maxillary plate with short truncate lobes; a knob on anterior margin and a spine on ventral surface of first antennae; ribs of suction cups with 12 to 13 segments, tapered but not imbricated. **paulensis*** (p. 572)

---

[12] New name for *maculosus* Meehean, preoccupied.

LITERATURE CITED

BASSETT-SMITH, P. W.

1899. A systematic description of parasitic Copepoda found on fishes, with an enumeration of the known species. Proc. Zool. Soc. London, 1899, pp. 438–507, 1 pl.

BERE, RUBY.

1931. Copepods parasitic on fish of the Trout Lake region, with descriptions of two new species. Trans. Wisconsin Acad. Sci., Arts and Lett., vol. 26, pp. 427–436, 2 pls.

1936. Parasitic copepods from Gulf of Mexico fish. Amer. Midl. Nat., vol. 17, pp. 577–625, 12 pls.

BOECK, AXEL.

1859. Tvende nye parasitiske Krebsdyr, *Artotrogrus orbicularis* og *Asterocheres lilljeborgii*. Forh. Vid. Selsk, Christiania, vol. 2, pp. 171–184 [1–12], 2 pls.

BRADY, GEORGE STEWARDSON.

1883. Report on the scientific results of the voyage of H. M. S. *Challenger* during the years 1873–76. Zoology, vol. 8, pt. 23, Report on the Copepoda, 142 pp., 55 pls.

DALL, WILLIAM HEALEY; BARTSCH, PAUL; and REHDER, HARALD ALFRED.

1938. A manual of the recent and fossil marine pelecypod mollusks of the Hawaiian Islands. Bernice P. Bishop Mus. Bull. 153, 233 pp., 58 pls.

HELLER, CAMILL.

1857. Beiträge zur Kenntniss der Siphonostomen. Sitzb. Akad. Wiss. Wien, math.-nat. Cl., vol. 25, pp. 89–108, 2 pls.

KAMPEN, P. N., VAN,

1909. Über *Argulus belones* n. sp. und *A. indicus* M. Weber aus dem Indischen Archipel. Zool. Anz., vol. 34, pp. 443–447, 6 figs.

KRØYER, HENRIK.

1863. Bidrag til Kundskab om Snyltekrebsene. Naturh. Tidsskr., ser. 3, vol. 2, pp. 75–426, 18 pls.

LEIGH-SHARPE, W. HAROLD.

1934. The Copepoda of the *Siboga* Expedition. Part II: Commensal and parasitic Copepoda. Siboga-Expeditie, Monogr. 29b, 40 pp., 39 figs.

MEEHEAN, OTIS LLOYD.

1940. A review of the parasitic Crustacea of the genus *Argulus* in the collections of the United States National Museum. Proc. U. S. Nat. Mus., vol. 88, pp. 459–522, 27 figs.

MILNE EDWARDS, HENRI.

1840. Histoire naturelle des crustacés, comprenant l'anatomie, la physiologie et la classification de ces animaux, vol. 3, 638 pp., 42 pls.

SCOTT, THOMAS.

1912. The Entomostraca of the Scottish National Antarctic Expedition, 1902–1904. Trans. Roy. Soc. Edinburgh, vol. 48, pt. 3, pp. 521–599, 4 figs. 14 pls.

SMITH, S. I. (See under VERRILL and SMITH.)

STEENSTRUP, JOHANNES JAPETUS SMITH, and LÜTKEN, CHRISTIAN FREDERICK.

1861. Bidrag til Kundskab om det aabne Havs Snyltekrebs og Lernaeer samt om nogle andre nye eller hidtil kun ufuldstaendigt kjendte parasitiske Copepoder. Danske Vid. Selsk. Skrift., ser. 5, vol. 5, pp. 341–432, 15 pls.

THIELE, JOHANNES.

1900. Diagnosen neuer Arguliden-Arten. Zool. Anz., vol. 23, pp. 46–48.

1904. Beiträge zur Morphologie der Arguliden. Mitt. Zool. Mus. Berlin, vol. 2, No. 4, 51 pp., 9 pls.

THORELL, T.

1865. Om *Argulus dactylopteri*, en ny Vestindisk hafs-argulid. Forh. Vet.-Akad. Stockholm, 1864, No. 10, pp. 609–614, pl. 16.

VERRILL, ADDISON EMORY, and SMITH, SIDNEY IRVING.

1873. Report upon the invertebrate animals of Vineyard Sound and adjacent waters, with an account of the physical features of the region. Rep. Comm. Fish and Fisheries, 1871–1872, pp. 295–778, 38 pls. [Reprint 1874.]

WEBER, MAX CARL WILHELM.

1892. Die Süsswasser-Crustaceen des indische Archipels . . . Zool. Ergebn. Niederl. Ost-Indien, vol. 2, pp. 528–571, 22 figs., 1 pl.

WILSON, CHARLES BRANCH.

1902. North American parasitic copepods of the family Argulidae, with a bibliography of the group and a systematic review of all known species. Proc. U. S. Nat. Mus., vol. 25, pp. 635–742, 20 pls.

1904. A new species of *Argulus*, with a more complete account of two species already described. Proc. U. S. Nat. Mus., vol. 27, pp. 627–655, 38 figs.

1907a. North American parasitic copepods belonging to the family Caligidae. Part 2.—The Trebinae and Euryphorinae. Proc. U. S. Nat. Mus., vol. 31, pp. 669–720, 19 figs., 6 pls.

1907b. Additional notes on the development of the Argulidae, with description of a new species. Proc. U. S. Nat. Mus., vol. 32, pp. 411–424, 4 pls.

1907c. North American parasitic copepods belonging to the family Caligidae. Parts 3 and 4.—A revision of the Pandarinae and the Cecropinae. Proc. U. S. Nat. Mus., vol. 33, pp. 323–490, 27 pls.

1911. North American parasitic copepods. Descriptions of new genera and species. Proc. U. S. Nat. Mus., vol. 39, pp. 625–634, 4 pls.

1912. Descriptions of new species of parasitic copepods in the collections of the United States National Museum. Proc. U. S. Nat. Mus., vol. 42, pp. 233–243, 5 pls.

1916. Copepod parasites of fresh-water fishes and their economic relations to mussel glochidia. Bull. U. S. Bur. Fish., vol. 34 (1914), pp. 333–374, 15 pls.

1921. New species and a new genus of parasitic copepods. Proc. U. S. Nat. Mus., vol. 59, pp. 1–17, 7 pls.

1923. Parasitic copepods in the collection of the Riksmuseum at Stockholm. Arkiv för Zool., vol. 15, No. 3, pp. 1–15, 2 pls.

1924. New North American parasitic copepods, new hosts, and notes on copepod nomenclature. Proc. U. S. Nat. Mus., vol. 64, art. 17, 22 pp., 3 pls.

1927. A copepod (*Argulus indicus*) parasitic on the fighting-fish in Siam. Journ. Siam Soc., Nat. Hist. Suppl., vol. 7, pp. 1–3, 1 pl.

1932. The copepods of the Woods Hole region, Massachusetts. U. S. Nat. Mus. Bull. 158, 635 pp., 316 figs., 41 pls.

1935. Parasitic copepods from the Pacific coast. Amer. Midland Nat., vol. 16, pp. 776–797, 6 pls.

1936a. Two new parasitic copepods from Cuban fish. Mem. Soc. Cubana Hist. Nat., vol. 10, pp. 107–112, 15 figs.

1936b. Copepods from the cenotes and caves of the Yucatán peninsula, with notes on cladocerans. Carnegie Inst. Washington Publ. No. 457, pp. 77–88, 2 figs.

1936c. *Argulus canadensis* from Cape Breton Island. Journ. Biol. Board Canada, vol. 2, pp. 355–358, 9 figs.

1942. Description of a new genus and species of copepod parasitic in a shipworm. Journ. Washington Acad. Sci., vol. 32, pp. 60–62, 1 fig.

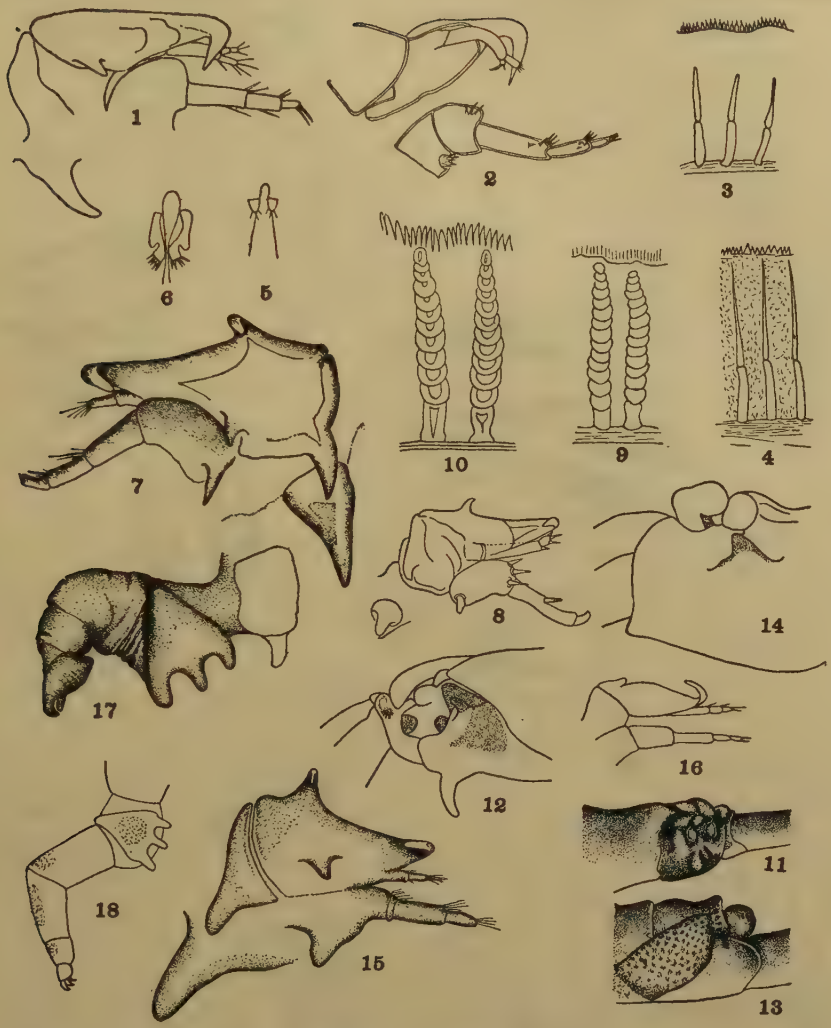
WRIGHT, EDWARD PERCEVAL.

1876. On a new genus and species belonging to the family *Pandarina*. Proc. Roy. Irish Acad., vol. 2, ser. 2, pp. 583–585, 1 pl.

WRIGHT, R. RAMSAY,

1885. On a parasitic copepod of the clam. Amer. Nat., vol. 19, p. 120.

U. S. GOVERNMENT PRINTING OFFICE: 1944



SPECIES OF ARGULUS

1, 3, 5, *Argulus appendiculosus* Meehean: 1, First and second antennae; 3, supporting rods in disk; 5, caudal rami.

2, 4, 6, *Argulus biramosus* Bere: 2, First and second antennae; 4, supporting rods in disk; 6, caudal rami.

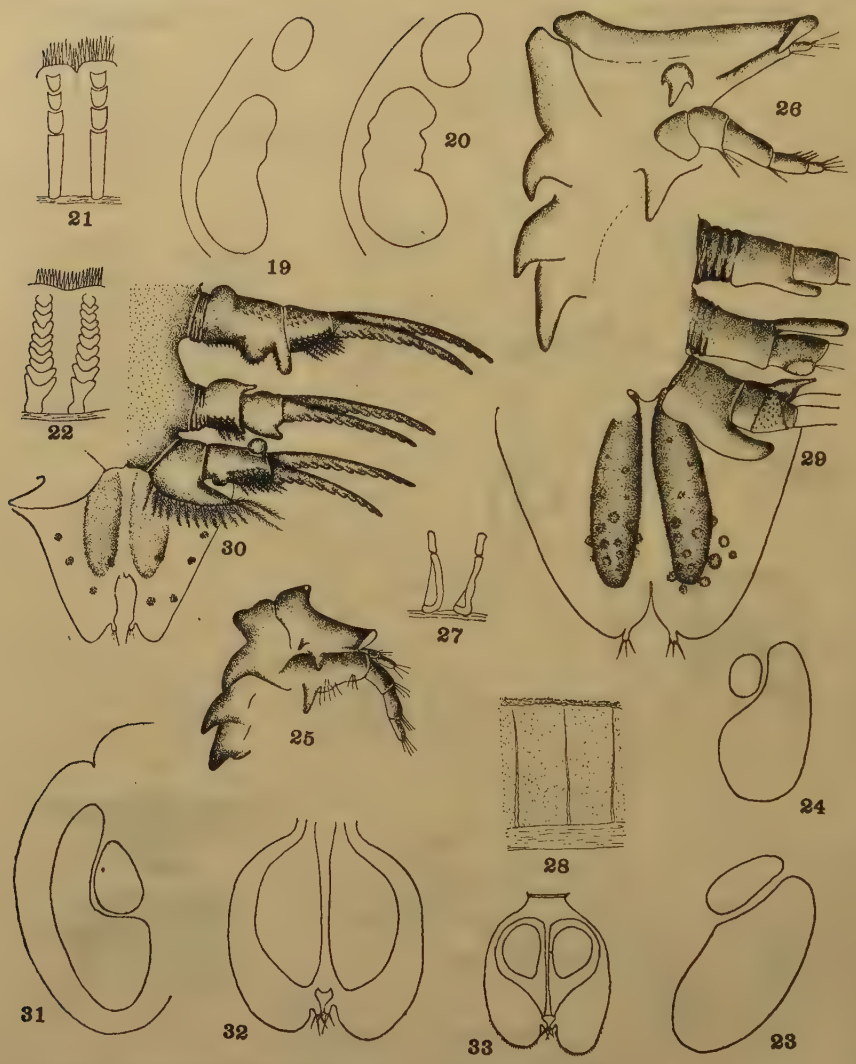
7, 9, 11, 13, *Argulus stizostethii* Meehean: 7, First and second antennae; 9, supporting rods in disk; 11, third legs of male; 13, fourth legs of male.

8, 10, 12, 14, *Argulus canadensis* Wilson: 8, First and second antennae; 10, supporting rods in disk; 12, third legs of male; 14, fourth legs of male.

15, 17, *Argulus niger* Wilson: 15, First and second antennae; 17, maxilliped.

16, 18, *Argulus pugettensis* Meehean: 16, First and second antennae; 18, maxilliped.

558871—44——5



SPECIES OF ARGULUS

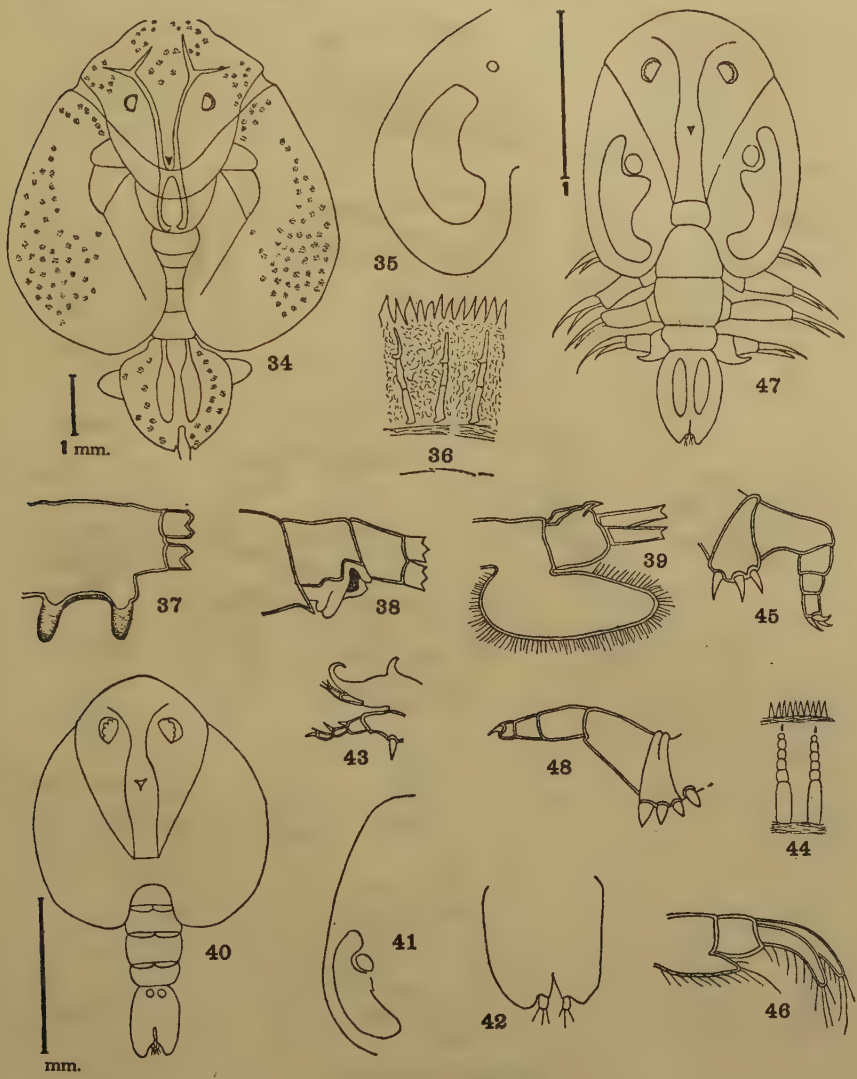
19, 21, *Argulus varians* Bere: 19, Respiratory areas; 21, ribs of sucking cups.

20, 22, *Argulus megalops* Smith: 20, Respiratory areas; 22, ribs of sucking cups.

23, 25, 27, 29, *Argulus americanus* Wilson: 23, Respiratory areas; 25, first and second antennae; 27, ribs of sucking cups; 29, accessory sex modifications on legs of male.

24, 26, 28, 30, *Argulus maculosus* Wilson: 24, Respiratory areas; 26, first and second antennae; 28, ribs of sucking cups; 30, accessory sex modifications on legs of male.

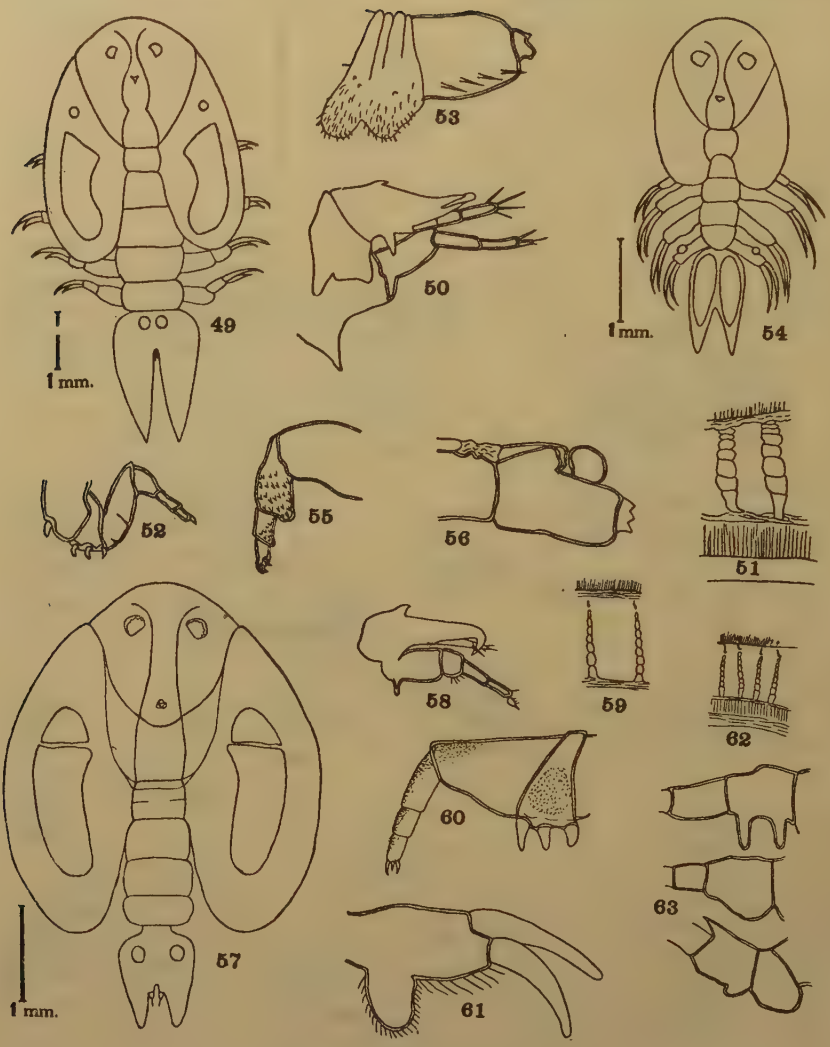
31–33, *Argulus paulensis* Wilson: 31, Respiratory areas of male; 32, abdomen of male; 33, abdomen of female.



SPECIES OF ARGULUS

34–39, 48, *Argulus indicus* Weber: 34, Dorsal view of male; 35, respiratory areas; 36, ribs of sucking cups; 37–39, sex modifications on second, third, and fourth legs; 48, maxilliped of male.

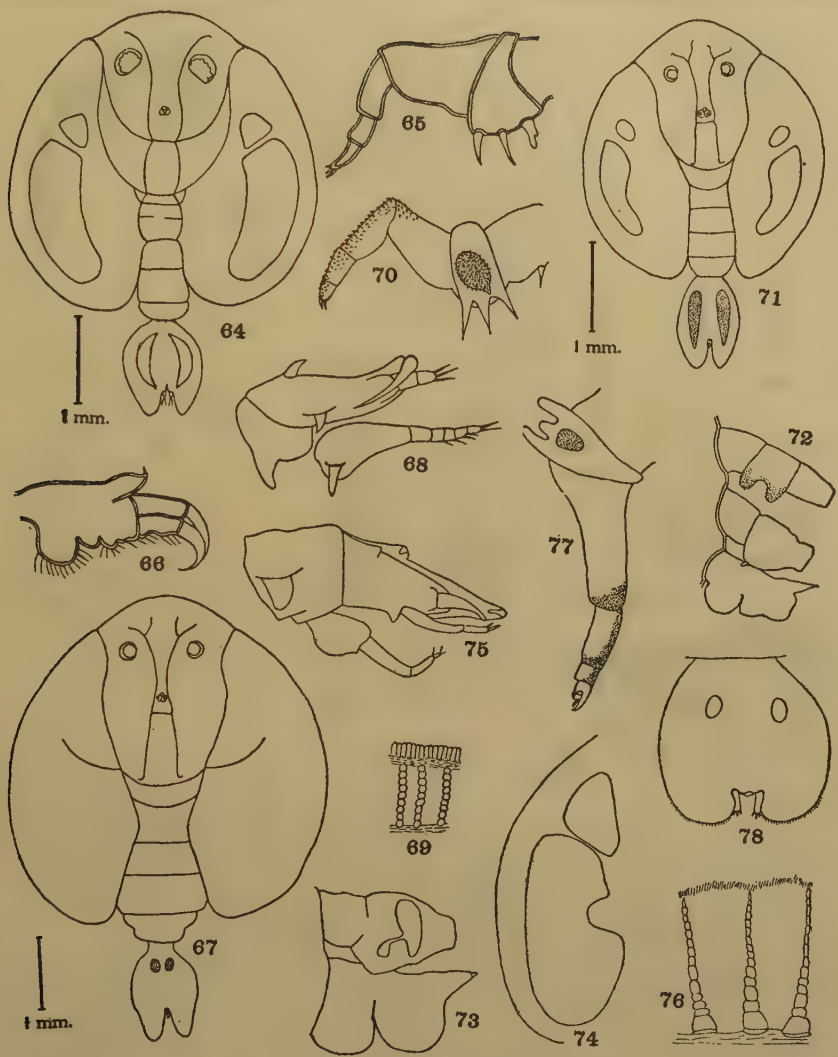
40–47, *Argulus intectus*, new species: 40, Dorsal view of female; 41, respiratory areas; 42, abdomen; 43, first and second antennae; 44, ribs of sucking cups; 45, maxilliped; 46, fourth leg; 47, dorsal view of male.



SPECIES OF ARGULUS

49–56, *Argulus longicaudatus*, new species: 49, Dorsal view of female; 50, first and second antennae; 51, ribs of sucking cups; 52, maxillipeds; 53, fourth basipod; 54, dorsal view of male; 55, maxilliped of male; 56, fourth leg of male.

57–63, *Argulus lunatus*, new species: 57, Dorsal view of female; 58, first and second antennae; 59, ribs of sucking cups; 60, maxilliped; 61, fourth leg; 62, ribs of sucking cups of male; 63, accessory sex modifications on second, third, and fourth legs of male.

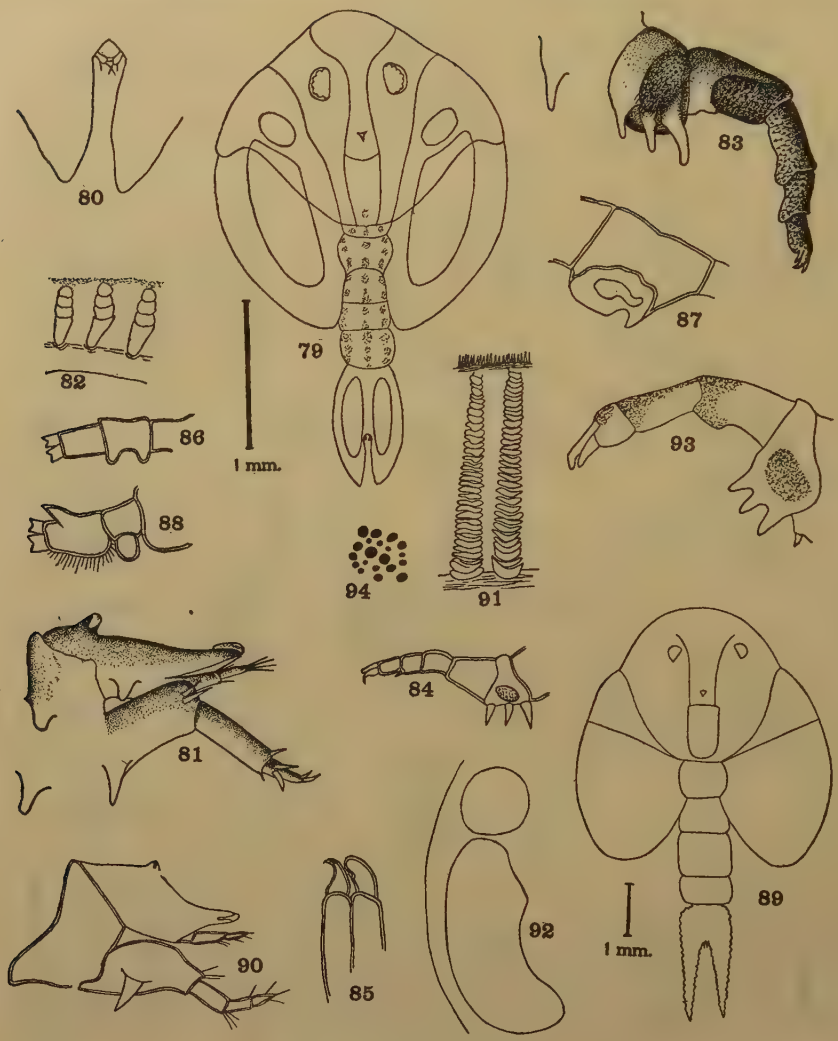


SPECIES OF ARGULUS

64–66, *Argulus lunatus*, new species: 64, Dorsal view of male; 65, maxilliped; 66, fourth leg of another male showing variation.

67–73, *Argulus japonicus* Thiele: 67, Dorsal view of female; 68, first and second antennae; 69, ribs of sucking cups; 70, maxilliped; 71, dorsal view of male; 72, accessory sex modifications of male legs; dorsal view; 73, the same, ventral view.

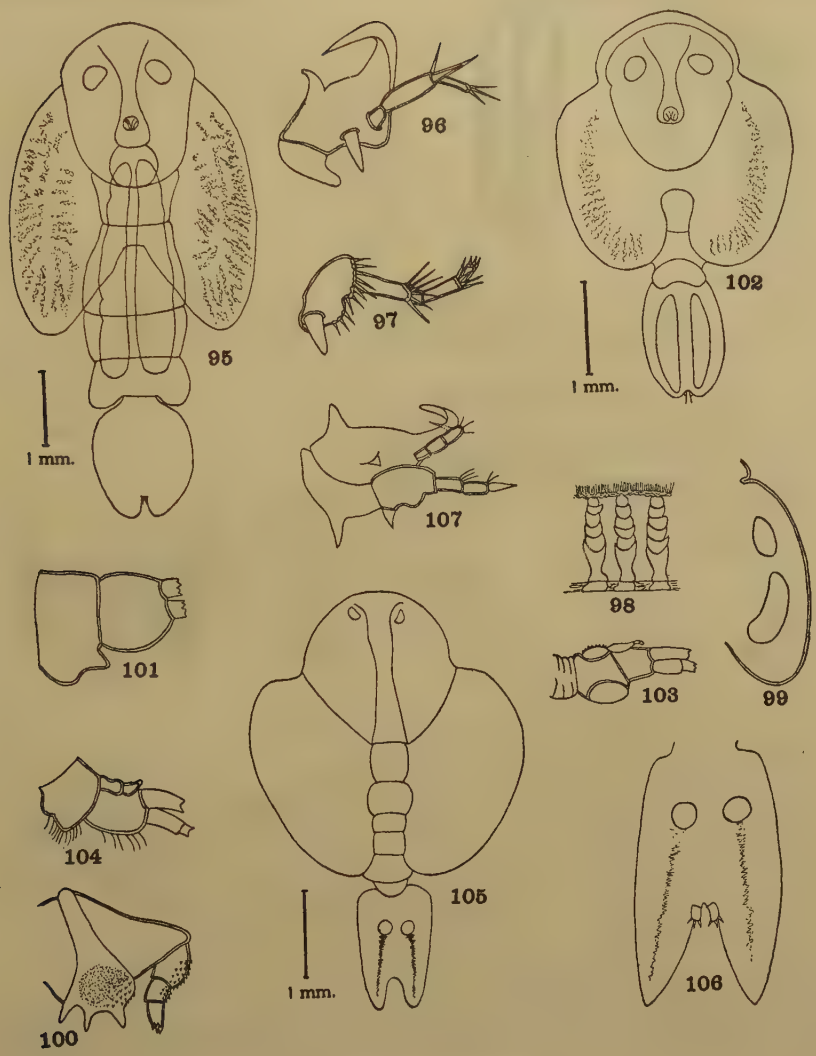
74–78, *Argulus nattereri* Heller: 74, Respiratory areas; 75, first and second antennae; 76, ribs of sucking cups; 77, maxilliped; 78, abdomen of female, dorsal view.



SPECIES OF ARGULUS

79–88, *Argulus trilineatus* Wilson: 79, Dorsal view of male; 80, abdomen showing caudal rami; 81, first and second antennae; 82, ribs of sucking cups; 83, maxilliped of female; 84, maxilliped of male; 85, tip of the same; 86–88, accessory sex modifications of second, third, and fourth legs.

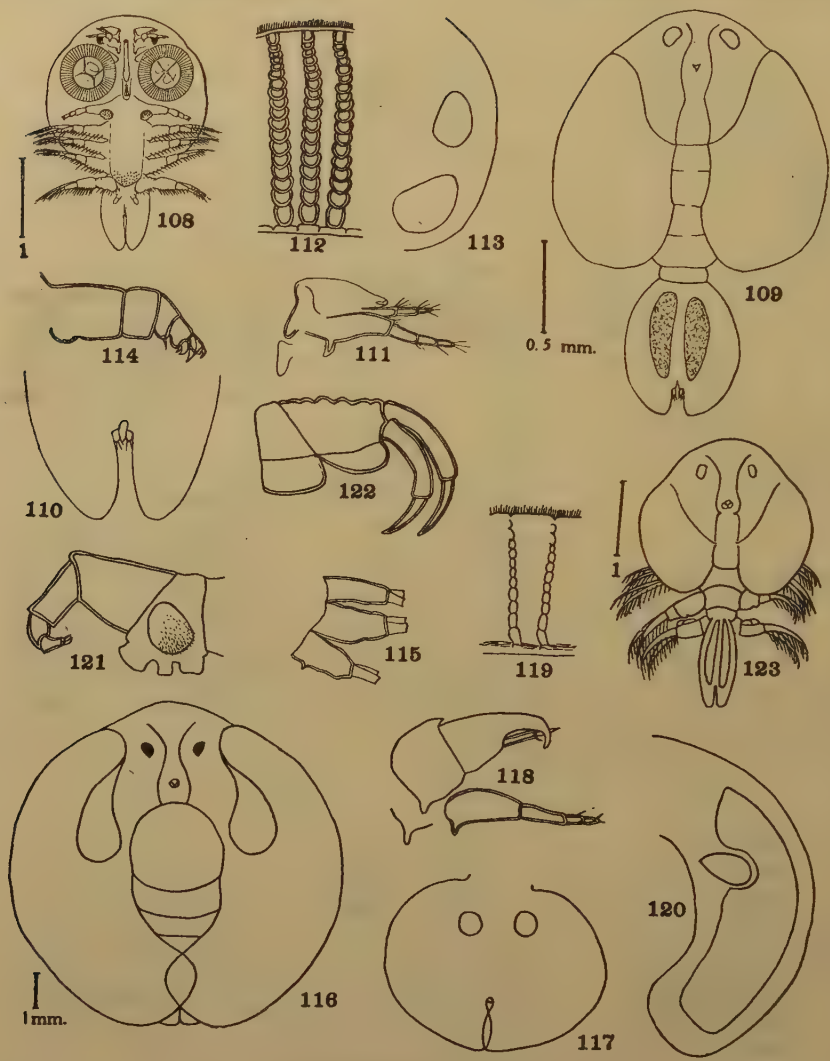
89–94, *Argulus melanostictus* Wilson: 89, Dorsal view of female; 90, first and second antennae; 91, ribs of sucking cups; 92, respiratory areas; 93, maxilliped; 94, spots on dorsal surface, showing relative size, the magnification one-half greater than in fig. 89.



SPECIES OF ARGULUS

95–104, *Argulus megalops spinosus*, new variety: 95, Dorsal view of female; 96, first antenna; 97, second antenna; 98, ribs of sucking cups; 99, respiratory areas; 100, maxilliped; 101, basipod of fourth leg; 102, dorsal view of male; 103, third leg of male; 104, fourth leg.

105–107, *Argulus varians* Bere: 105, Dorsal view of female; 106, abdomen; 107, first and second antennae.

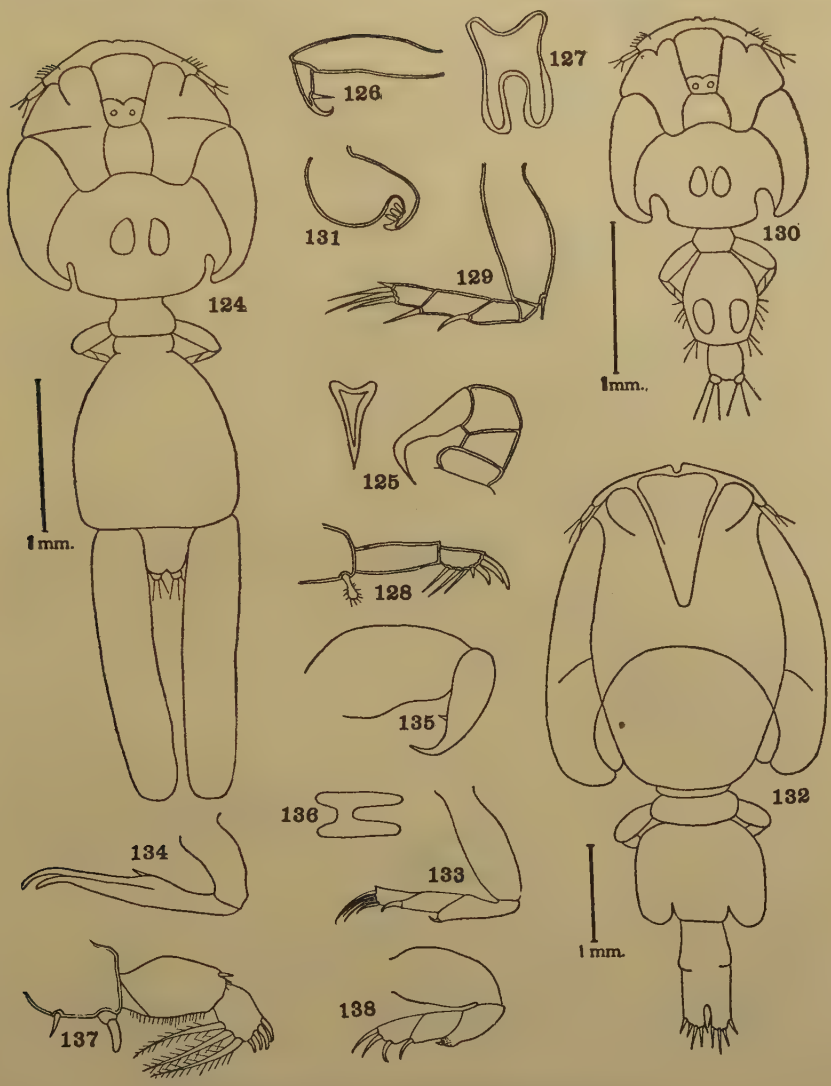


SPECIES OF ARGULUS

108–115, *Argulus latus* Smith: 108, Ventral view of female (drawn by J. H. Emerton); 109, dorsal view of male; 110, abdomen with caudal rami; 111, first and second antennae; 112, ribs of sucking cups; 113, respiratory areas; 114, maxilliped; 115, second, third, and fourth legs, with almost no modifications.

116–122, *Argulus rotundus*, new species: 116, Dorsal view of female; 117, abdomen; 118, first and second antennae; 119, ribs of sucking cups; 120, respiratory areas; 121, maxilliped; 122, fourth leg.

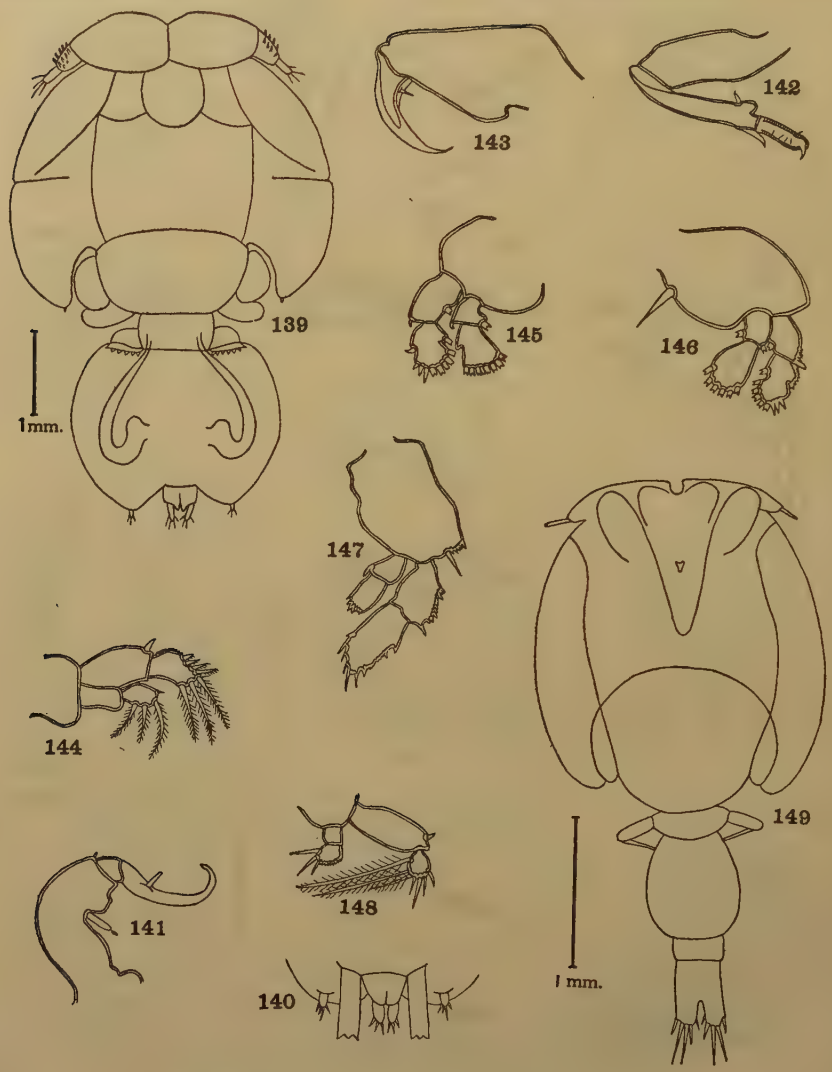
123, *Argulus funduli* Krøyer: Dorsal view of male, for comparison with fig. 109.



SPECIES OF LEPEOPHTHEIRUS

124–131, *Lepeophtheirus christianensis*, new species: 124, Dorsal view of female; 125, second antenna and first maxilla; 126, maxilliped; 127, furca; 128, first leg; 129, fourth leg; 130, dorsal view of male; 131, second antenna of male.

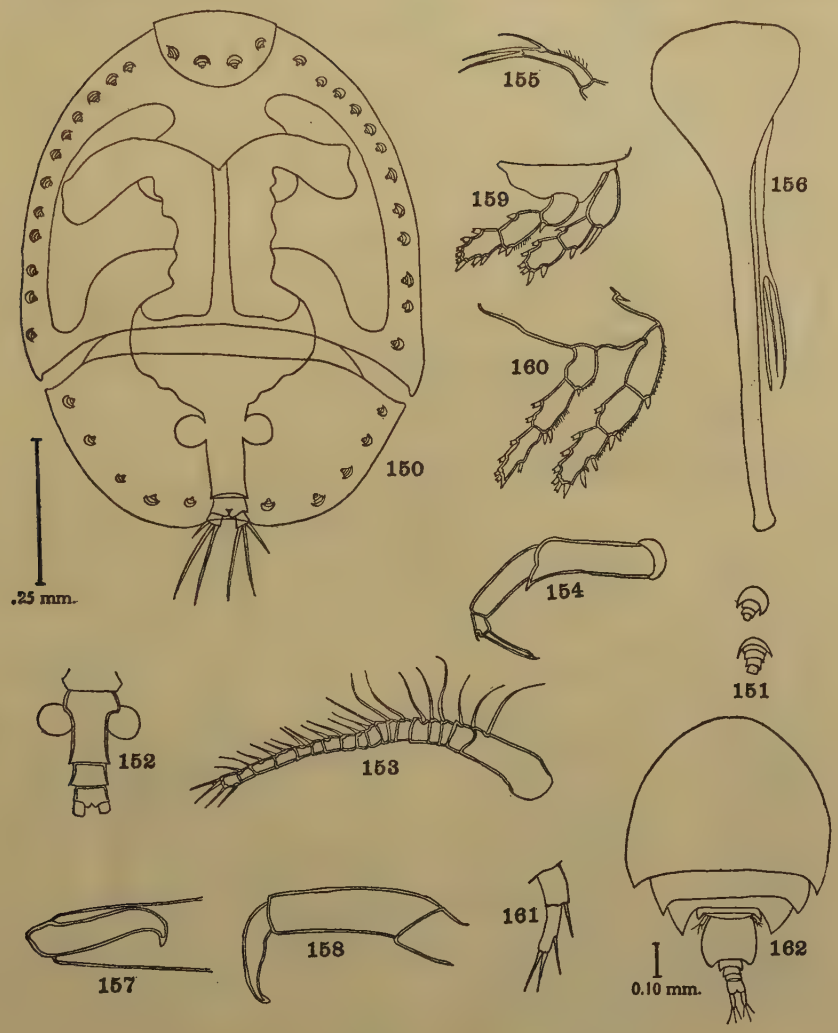
132–138, *Lepeophtheirus eminens*, new species: 132, Dorsal view of female; 133, fourth leg of female; 134, second maxilla; 135, maxilliped; 136, furca; 137, first leg; 138, fourth leg of male.



SPECIES OF DYSGAMUS AND LEPEOPHTHEIRUS

139–148, *Dysgamus atlanticus* Steenstrup and Lütken: 139, Dorsal view of female; 140, ventral view of abdomen; 141, second antenna; 142, second maxilla; 143, maxilliped; 144, first leg; 145, second leg; 146, third leg; 147, fourth leg; 148, first leg of male.

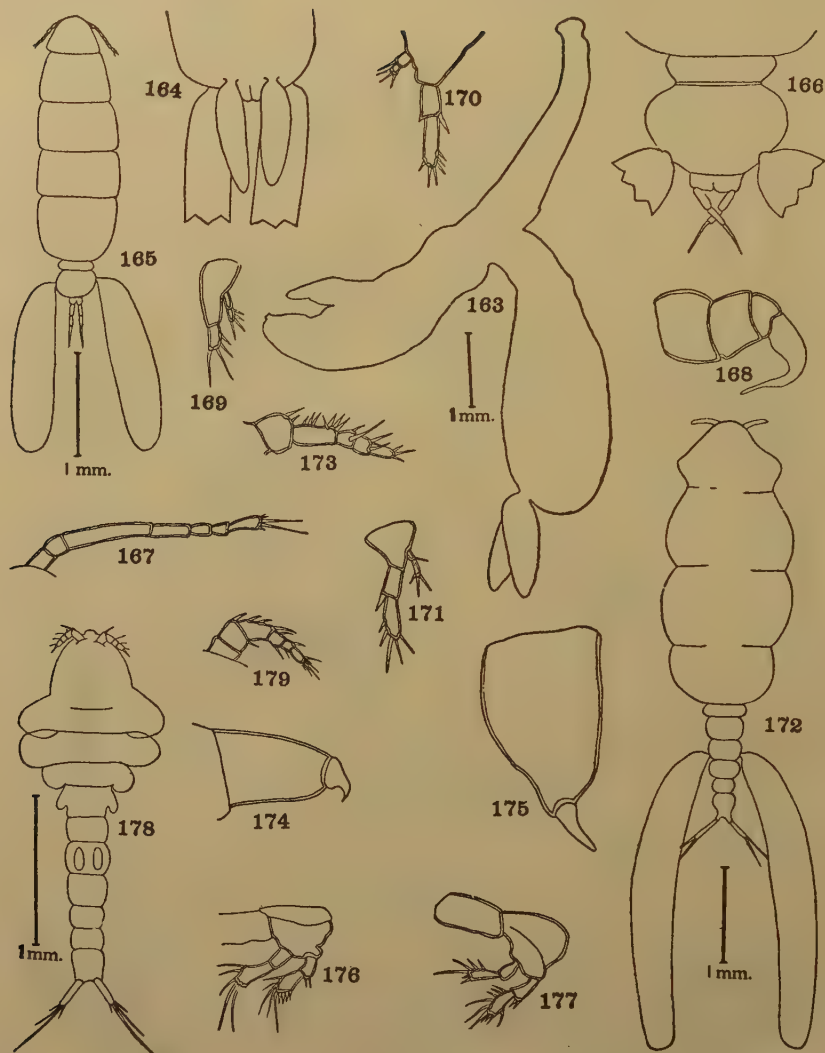
149, *Lepeophtheirus eminens*, new species: Dorsal view of male.



SPECIES OF PARMULODES AND ASTEROCHERES

150–160, *Parmulodes verrucosa*, new genus and species: 150, Dorsal view of female; 151, skin glands; 152, genital segment and abdomen; 153, first antenna; 154, second antenna; 155, fifth leg; 156, mouth tube with first maxilla; 157, second maxilla; 158, maxilliped; 159, first legs; 160, third legs.

161, 162, *Asterocheres lilljeborgii* Boeck: 161, Fifth leg; 162, dorsal view.

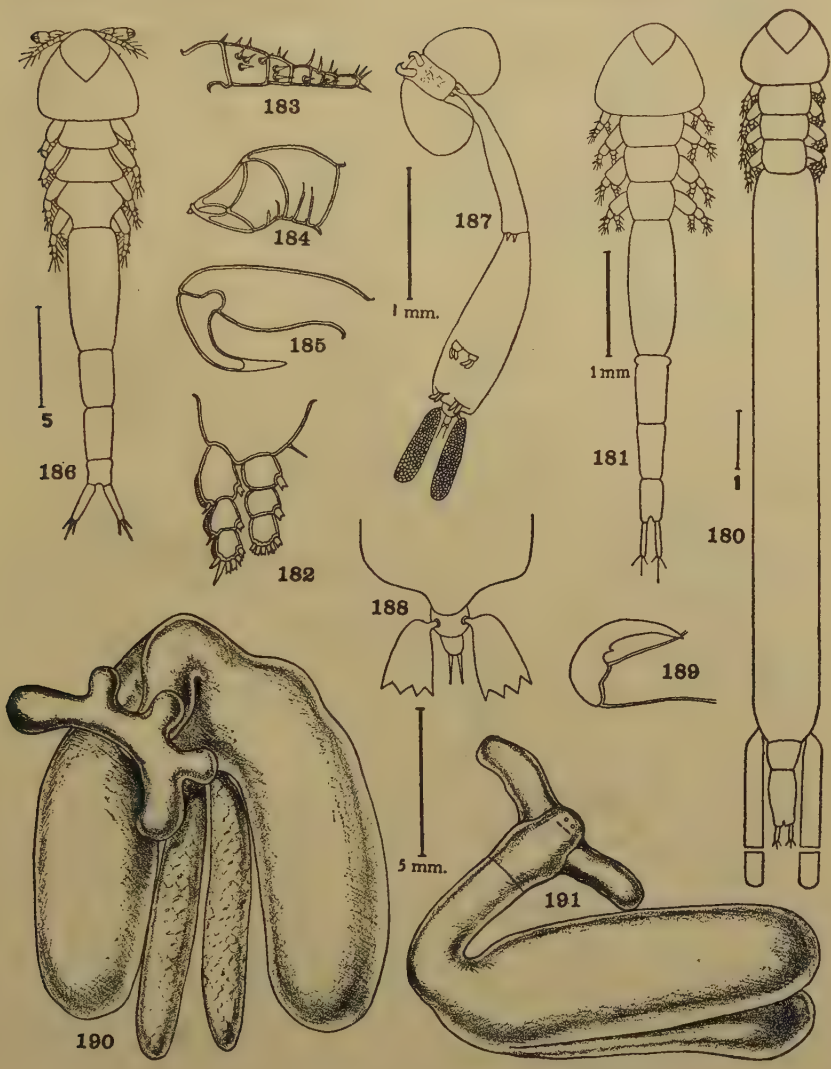


SPECIES OF BRACHIELLA, PESTIFER, AND TEREDICOLA

163, 164, *Brachiella squali*, new species: 163, Lateral view of female; 164, dorsal view of posterior processes and egg strings.

165–171, *Pestifer agilis*, new genus and species: 165, Dorsal view of female; 166, dorsal view of genital segment and abdomen; 167, first antenna; 168, second antenna; 169–171, first, third, and fourth legs.

172–179, *Teredicola typica* Wilson: 172, Dorsal view of female with egg strings; 173, first antenna; 174, second antenna; 175, maxilliped; 176, first legs; 177, second legs; 178, dorsal view of male; 179, first antenna of male.



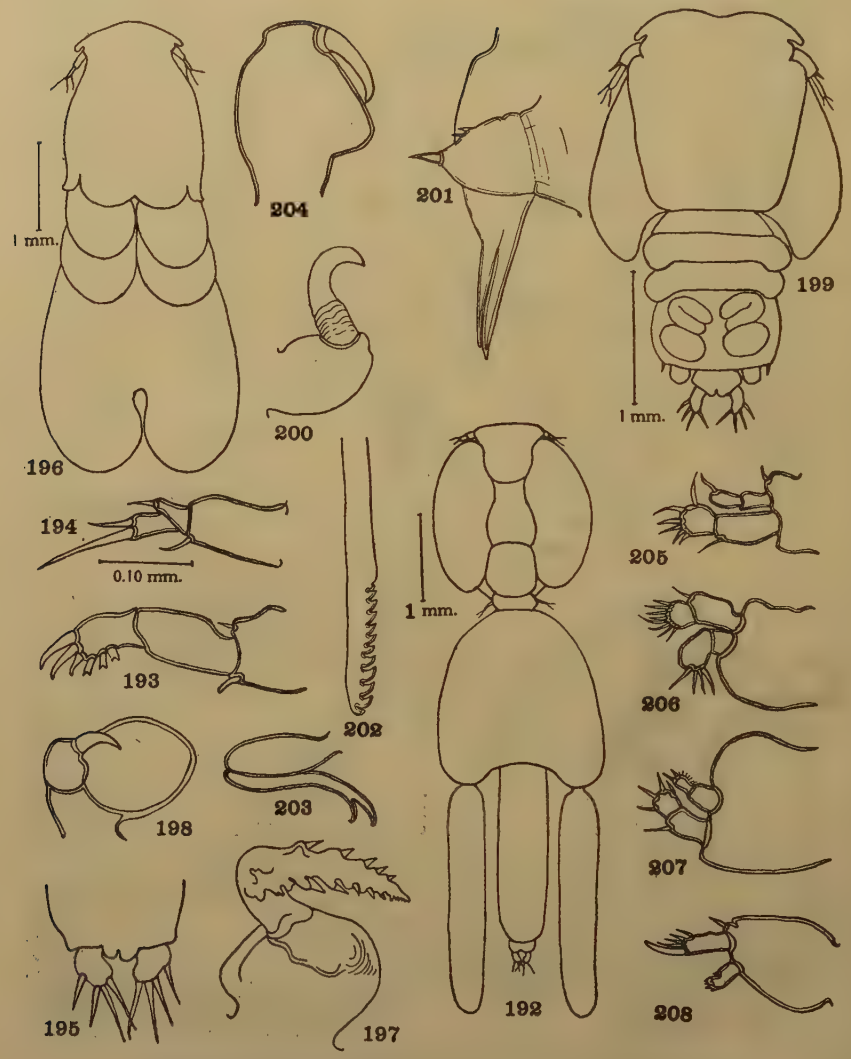
SPECIES OF KRØYERINA, PAEONODES, AND LERNAEOSOLEA

180–185, *Krøyerina elongata* Wilson: 180, Dorsal view of female; 181, dorsal view of male; 182, first leg; 183, first antenna; 184, second antenna; 185, maxilliped.

186, *Krøyerina nasuta* Wilson: Dorsal view of male to contrast with fig. 181.

187–189, *Paeonodes exiguus*, new genus and species: 187, Ventral view of female with egg strings; 188, dorsal view of genital segment and abdomen; 189, second antenna.

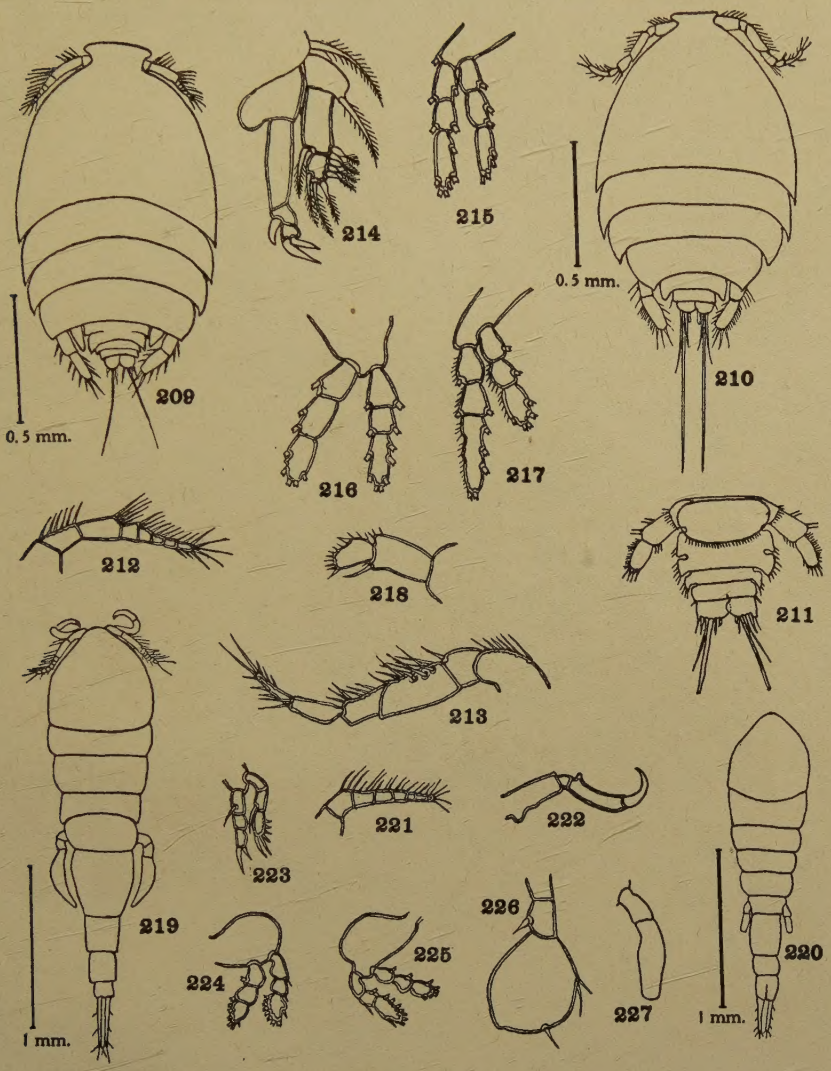
190, 191, *Lernaeosolea lycodis*, new species: 190, Dorsal view of female; 191, lateral view of same specimen.



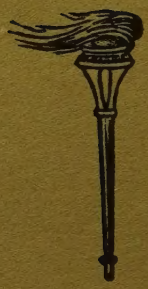
SPECIES OF LEPEOPHTHEIRUS AND ACHTHEINUS

192–195, *Lepeophtheirus marcepes*, new species: 192, Dorsal view of female; 193, first leg; 194, fourth leg; 195, abdomen and caudal rami.

196–208, *Achtheinus dentatus* Wilson: 196, Dorsal view of male; 197, second antenna; 198, maxilliped; 199, dorsal view of male; 200, second antenna; 201, mouth tube and first maxilla; 202, mandible; 203, second maxilla; 204, maxilliped; 205–208, first, second, third, and fourth legs.



SPECIES OF UNICALTEUTHA AND OSTRINCOLA

209–218, *Unicalteutha ovalis*, new genus and species: 209, Dorsal view of female; 210, dorsal view of male; 211, fifth segment, genital segment, abdomen, and caudal rami of female in dorsal view; 212, first antenna of female; 213, first antenna of male; 214–217, first, second, third, and fourth legs of female; 218, fifth leg of male.

219–227, *Ostrincola gracilis*, new genus and species: 219, Dorsal view of female; 220, dorsal view of male; 221, first antenna of male; 222, second antenna; 223, first leg; 224, third leg; 225, fourth leg; 226, fifth leg of female; 227, fifth leg of male.